AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 7, No. 16. WEEKLY. | NEW YORK, APRIL 19, 1884. | $2.50 per Annum. SINGLE COPIES, 5 CENTS.

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Eighty-four Inch Milling Machine.

This machine is one of a series made by the Brainard Milling Machine Company, of Hyde Park, Mass., intended for long and heavy milling, and in which the table has only a longitudinal motion, while provision for vertical and crosswise movements are made in the head which carries the driving mechanism. The other machines of the series are the "50-inch" and the "72-inch;" both of which have been made for many years by the above-named company, while the "84-inch" is a machine of recent design.

The machine table sets low on a bed supported by four box legs, and is actuated by a steel screw driven by a worm and worm gear connected with a pair of spur gears. The gearing is outside the bed, and therefore accessible, and is protected by a shield, as shown in cut. The arrangement for belting to feed works is also shown too plainly to need description. The head upon which the spindle carrier is mounted travels in ways upon the bed, and is adjusted crosswise on it by means of a screw connected with a hand wheel, partially shown at the left of engraving. For convenience, and ease in fine adjustment this wheel, and also the wheel at top of machine, connected with the elevating screw, are worked by a hand lever, the wheels having sockets in their periphery for this purpose.

The carrier upon which is mounted the driving spindle is gibbed to the head, and has a vertical range sufficient to allow work 18 inches high to pass under centers. From this carrier projects a large arm for outside center support of mill spindle, intended for use on work where a back stand is not admissible. There is, however, as may be seen, a back stand or tailstock of very solid character. The arm is readily removable, when desired, or the tailstock can be slid off its seat if required. In most cases, however, the arm need not be removed, the yoke on it being swung up out of the way, leaving the center of mill arbor free to engage with that on the back stand. This combination provides for operating on a wide range of work.

As shown in the engraving, the space between head and tailstock is about 24 inches, but if required the tailstock can be made to travel in line with the head, and its support be extended to any distance desired.

The method of driving the spindle is simple and strong, and allows of free adjustment of the spindle without disarrangement of the driving and feed belts.

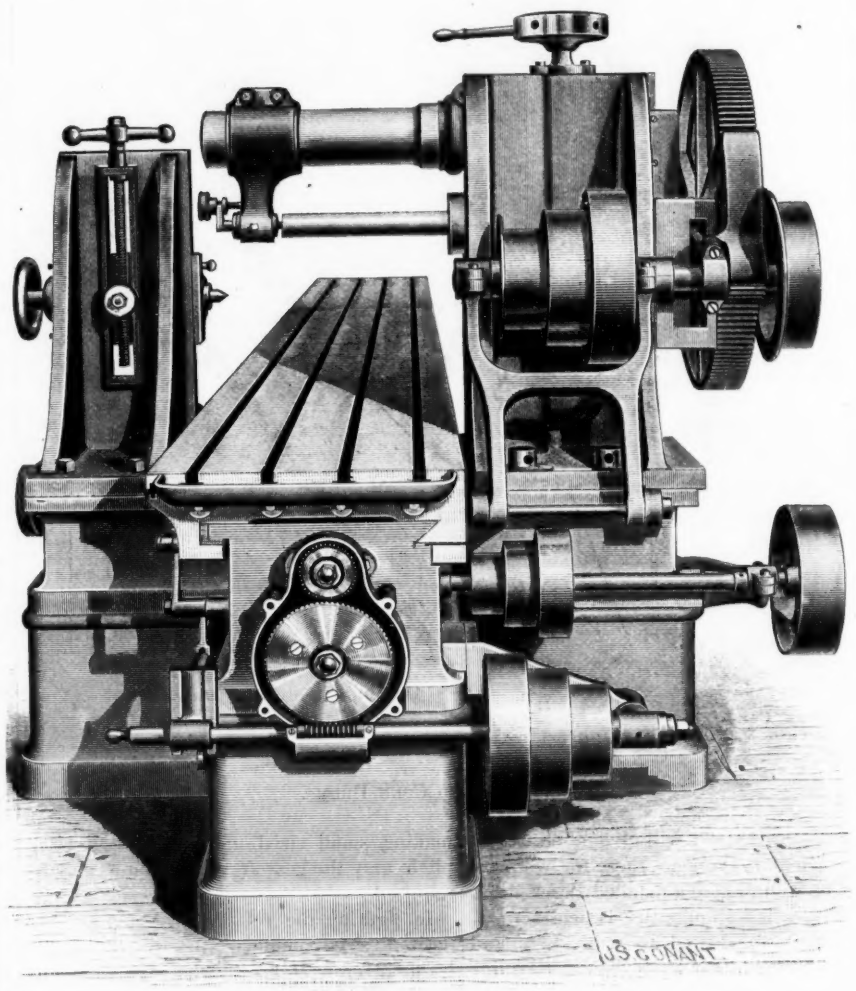
The cone, which is made for 3½″ belt, is mounted in a stirrup which is pivoted to the bed, and the pinion which engages with the driving gear on the spindle is held at correct distance by a connecting yoke, and is driven by a feather.

The machine has longitudinal feed only, but where it is desired an automatic feed motion can be applied to the elevating screw in the head, giving feed in a vertical direction.

The table is arranged to be run back rapidly by power, by a device which is not seen in the engraving. As the table weighs one ton, the relief to the operator by this improvement is obvious.

All the operations of the machine are intended to be conducted from the front side, without any change in the position of the operator. The feed can be thrown out by hand at any moment by means of a rod which connects with the latch shown at the front of the cut, and the power quick-return applied, or the table can be run back by hand, and the feed thrown in by a foot lever, which lifts the drop box shown in front of cut. Adjustable dogs automatically drop the feed motion at any point.

The machine is massive in all its parts, and is intended for heavy milling of any description, but more particularly for shafting, railroad or engineering shops, being specially adapted for key-seating long and heavy shafting, finishing guide bars, connecting rods, etc.



NEW EIGHTY-FOUR INCH MILLING MACHINE.

Its weight is 7,500 pounds. The work table is 7 feet long by 20 inches wide; length of longitudinal feed, 84 inches; distance between uprights, 24 inches. The cast steel spindle is 4 inches in diameter, and the mill arbor 2½ inches diameter. Arm for outer center support 5 inches diameter at its smallest part.

Solid drawn steel tubes are made in England and imported upon order. They are quite smooth and straight, both inside and outside, and will stand great pressure. Most of the demand is for hydraulic purposes. The importer of these tubes informs us that the largest size now made is 4½″ outside and 4″ inside diameter, and that this size costs $5 a foot. The demand is increasing, and the works run day and night. A very large amount of money was spent in experimenting before the process was made entirely successful.

Vertical Boilers—Boilers for Heating.

BY GEORGE MARSHALL.

The vertical boiler having received but brief mention under the heading "What kind shall I buy?" a more general reference to it at this time perhaps is necessary. Boilers of this type vary in many particulars. In some the tubes run from the crown sheet, or top of fire-box, to the top head of boiler. This is objectionable in many instances from the simple fact is the portion of the tubes above the water line is exposed to an intense heat during the process of firing, previous to the generation of steam, and where a light quick fire is used the tubes become leaky after short use. There are, however, many engineers who claim for such a boiler a drier quality of steam, more elastic and expansive in its duties in the cylinder, and for this reason a preference is given by them to this type.

Another method of making a vertical boiler is to have the frustum of a cone extending downward from the top head, the base of which forms the upper tube head, the cone varying in height to suit the boiler-maker's ideas, or perhaps to suit the quantity of heating surface required. In boilers of this style, the intention is to have the entire tube protected by water, the lower part, or base of the cone, being below the water line at all times, the upper section of boiler acting as a reservoir and superheater for the steam. The top part of the cone frustum is made of proper size to permit the free passage of the gases, smoke and waste heat, generally equal to the aggregate tube area. This boiler is much more durable than the former, and is to be preferred.

Some builders form the bottom of furnace with a cast or wrought ring, by this means connecting the shell to fire box; others make the bottom of fire-box in the "ogee" form, answering in a measure the same purpose as the ring, at reduced weight and cost. The door ring is made in the same way as the bottom ring. In some cases the fire-box is flanged outward to the shape and diameter of the shell; in others a cast or wrought frame is introduced between the two sheets. In both of the boilers here described the flame and gases are liberated after going through the tubes, while in other forms the water space is made sufficiently large to permit an outward row of tubes to extend from top head to bottom of boiler, through which the products of combustion must first pass and then either return to the top around the shell or else pass off through a suitable flue at the bottom. It is hardly necessary to say that in this style the bottom ring must be made of plate metal, and it is usual to turn one flange up and the other down, to facilitate construction.

Another type of vertical boiler used quite extensively in house heating is made by having a conical fire-box, extending from top to bottom of boiler, with an outer row of tubes, as described, and for the purposes mentioned in the previous description. There are, besides these, various other styles of vertical boilers, some of which are made almost entirely of cast iron, but those referred to are most frequently found in general use. In making boilers of this kind the principal idea is "to get the greatest power into the least possible space," and as a consequence countless tubes are crowded into the crown sheet, no provision being made for properly cleaning the flat surface exposed to the greatest heat, the crown sheet being level, or supposed to be so, and the tubes crowded as described. The solid matter contained in solution in all water, on being precipitated, falls on this level surface, and the circulation being impeded by the great number of tubes exposes the latter to an intense heat, without any protection from the water, and the result in a short time is "leaky tubes," which can only be properly repaired by removal, cleaning the crown through the holes and putting in new tubes, to repeat the operation in a short time. Where muddy or hard water is used great trouble and expense is experienced by those using vertical boilers, and this finally leads to the horizontal, or some other type being substituted.

Boiler makers take very little interest in such boilers, and it is a common occurrence to see boilers of this type entirely unprovided with hand holes to permit the removal of sediment from bottom or crown. There should be in all vertical boilers hand-holes in such places as will admit of cleaning, and the tubes should be so arranged that some instrument can be introduced between them on a line with the crown sheet to remove the scale. The use of a hose with sufficient force of water will accomplish much in this respect, but if the scale is not loosened before the water is introduced much good cannot follow.

The "ogee" form for bottom of fire-box

and door ring is not advisable, as the fire-box plate, being seldom over ¼″ thick is necessarily considerably reduced by being worked to an increased diameter; but questions of this kind are not always considered in their proper light by the boiler maker, whose great object is to get out the work in the cheapest manner. There are some who will not build cheap work, and who will not estimate on boilers where a poor quality of material is required. Unfortunately this class are in a decided minority, but they have the satisfaction of getting a good price for their product, and a reputation better than money.

For engine use I never recommend the vertical boiler, my objections being based on experience that justifies me in saying that a waste of fuel follows their introduction. I have known of vertical boilers being replaced by horizontal of 50 per cent. more power, and no increase of consumption of fuel following.

Claims are advanced by interested parties for "improved" vertical boilers more economical than any other type, and data furnished to substantiate the claim, but as I have no faith in tests without considering other equally important questions, my experience is against the use of a vertical boiler where another type can be as easily located and used. For hoisting engines, boilers of this kind are commonly used, and where there is fair water, give good satisfaction; but beyond a certain power they are quietly passing away, while for house warming purposes (steam now being considered cheaper than furnace heat) they are, under modified forms, becoming generally used. For this last named purpose there can be no great objection to their use, as the water is returned to the boiler and the trouble caused by sediment is thus in a great measure removed; even in the worst cases of impure water, the quantity of fresh water required being so small that the accumulation of impurities is reduced to a minimum.

The business of heating public and private buildings by steam having become a regular industry competition, sharp and close, is the result, and to those who contemplate the use of steam and its appurtenances in their buildings a little advice may not be out of place. It is as follows:

Do not be deceived by the claims made in favor of their own invention by the parties most interested in its introduction. Do not believe any man who tells you that the consumption of fuel for the average season can be reduced 50 or 75 per cent. by the purchase and use of his patent boiler and appliances. It can't be done. If you want a given temperature it takes fuel to get it, no matter what you use, and coal costs money. Do not place the greatest faith in the most fluent talker. If you do you will frequently be deceived, as his talk is sometimes his entire stock in trade. When you want a plant of this kind, closely examine in person the workings and cost of as many different plans as you possibly can, and when you have found what you think is the best do not allow a question of dollars and cents to influence you in your selection, as money saved in this way is generally a poor investment. Reputable business men require only a fair profit in their business, and give a fair equivalent to their patrons.

Some one has remarked that no one builds a machine shop without intentions of future enlargement, but, assuming the intention, there is a good deal of difference in the way the matter is looked at in the beginning. Occasionally wise provisions are made for the inevitable enlargement, so that when it comes about walls come out of the way as though they had never existed, and the completed building looks and is better than the original because it completes the design. But this unfortunately is not generally the case. On the contrary additions are made as business demands, which do not harmonize with the original, because not considered in the original design, and for the same reason the whole is frequently the reverse of convenient. A little forethought in the beginning is frequently all that is required to save a good deal of trouble and expense.

Sweeping Grooved Cone Drums.

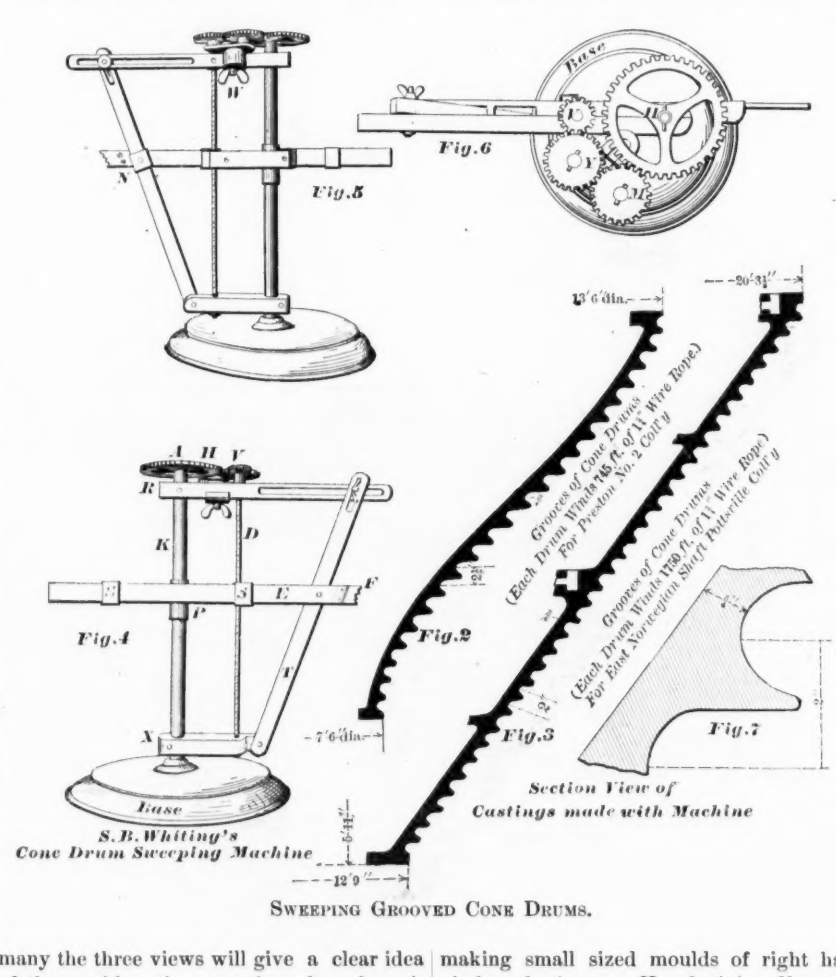
By Thomas D. West.

The machine shown is intended for sweeping either right or left hand, grooved drums, of cylindrical, conical, or any other shape, and of any pitch desired.

The originator of this device, S. B. Whiting, M. E., of Pottsville, Pa., first used it in 1867 or 1868, since which time a great number and variety of grooved drums have been made with it. At the right are sections of what were no doubt very large cone castings to make. The one in Fig. 3 was of twelve and twenty feet diameters, with a height of about six feet. Our trade is under obligations to Mr. Whitney for the successful accomplishment of such a job.

Among our best moulders but very few have any knowledge or idea of cone drum sweeping, and upon reading this many will, like the writer, feel like tendering Mr. Whiting thanks for allowing the publication of his device.

The engravings are from photographs taken from a model, therefore the proportions will differ somewhat from those of a full-sized working machine; and while to many the three views will give a clear idea of the machine, there are those for whom it might be well to give a detailed description.



Sweeping Grooved Cone Drums.

A, Fig. 4, is a spindle that is held stationary in the base. Fitted to work upon and around this spindle is a sleeve *K*. To guide and hold the arm *E* at a right angle to *K*, is the cross-head center *P*. The arms *R* and *X* are firmly secured to sleeve *K*, and therefore will cause the latter to rotate around the spindle *A*, when operating the machine. The cross-head *P* slides up or down upon the sleeve *K*, being controlled in its motion by the screw *D*. The bar *E* (carrying at its end the former or sweep *F*), slides in the cross-head guides *SS*, and is controlled in its movements, lengthwise, by the bar or former, *T*, which may be set at any angle, and may be straight, curved, or of an irregular form. The gear *H* being fast to the spindle *A*, the screw *D* will be turned whenever the bar *E* is swept around the mould. By changing the gear on the screw *D* and spindle *A*, any pitch may be obtained, and by inserting either one or two intermediate gears a right or left hand pitch may be obtained. The opposite side view of Fig. 4 is shown in Fig. 5. As will be seen at *N*, the bar *E* is there guided, as well as at *SS*, Fig. 4. Fig. 6 is a plan view of the intermediate and principal gears. As there are four wheels, the use of the two, *V* and *M*, may not appear plain. These gears (*V* and *M*) neither increase nor decrease speed, but are simply for making either right or left drums or pitches. Were wheels required for one hand sweeping only, then these gears would not be required, unless the centers *A* and *V* were so far apart that they were necessary to transmit motion.

As shown, the intermediate gear *M* is the one engaged with the large wheel *H*, and will produce a right hand drum or pitch. To produce a left hand drum, the thumb-screw *W*, Fig. 5, is loosened, and the gear *V* is made to engage direct with the large wheel *H* and pinion *V*.

The screw *D* should, according to the diameter of the mould, be set to balance the bar *E* in about the relation to the centers between the sleeve *K* and bar *T*, as here shown. In other words, the screw *D* should be set so as to balance, at an average, the bar *E* in its up or downward movement.

When arranging gears for moulds of large diameters, the gears *V* and *M* could, to save using a large center-wheel and pinion, be reversed so as to stand between the pinion *V* and large wheel *H*. To make an opposite hand drum, the two pinions would require to be replaced by three smaller ones. For making small sized moulds of right hand pitch, only the gear *H* and pinion *V* may be required.

In figuring the relation of gears to give desired sized moulds, the pitch of the leading screw *D* will be the regulator. As an example, we will suppose the leading screw *D* to have ½″ pitch. (By pitch is meant that every time the screw revolves once the thread would cause a nut to raise in height ½″.) Now, supposing there was to be a cone made having a 2″ pitch, as seen in section, Fig. 7, the arrangement should be such as to cause the sweep *F*, Fig. 4, to raise in height 2″ every time the sweep revolves once. Knowing that the leading screw raises ½″ every revolution, the gears must be made so that in every revolution of the sweep the leading screw will revolve four times, in order to raise the sweep 2″ in one revolution. Now, knowing that the leading screw pinion *V* must revolve four times in order to raise the sweep 2″ in one revolution, it will be seen that the large wheel *H* must contain four times the number of teeth that the pinion has; therefore if the pinion has, say 12 teeth, the large wheel must have 48 teeth.

Did one wish to make a mould having grooves of 3″ pitch, by using the same ½″ pitch leading screw, the gears *V* and *H* would require changing so as to cause the pinion *V* to revolve six times to once of the sweep.

To construct a 1″ pitch with the above leading screw the gears would require changing so as to cause the pinion to revolve twice to once of the sweep. For the construction of any fraction of the above pitches, the gears would, of course, require proportionally changing.

The pitch for the leading screw would, for general work, be better if ¼″. The ½″ pitch could, of course, be used, but such a coarse feed for fine pitches is objectionable. For grooves above 2″ pitch, ½″ pitch would be best.

The spindle *A* is not necessarily secured in such a base as shown. The idea is simply that it must be firmly held in something that will remain stationary. While the spindle is shown here self-supporting, it would be better for general work were the top supported by a brace. To do this the spindle would require to be prolonged further above the wheel than here shown.

While there are no sizes given, any one requiring such a machine can very readily, from the views and description, proportion and construct such a machine as the size of a job may require.

C. W. Jenkins, of Salisbury, Massachusetts, has invented and patented an improvement on the compound engine. The invention consists of means for exhausting the steam direct from the high pressure cylinder to the condenser at the point when the pressure in the low pressure cylinder gets equal to that in the high pressure cylinder. By this means it is claimed the back pressure will be taken away from the high pressure cylinder and also give it the benefit of the vacuum in the condenser.

The Legislature of Kentucky has passed a law making it a crime to use bicycles on the roads in certain counties of that State. The reason given for this action is that bicycles frighten horses, and have caused accidents by runaways in some instances. This is a bugbear which has been used to obstruct the application of machinery to road traction all over the world, and steam motors would be running the street cars in many cities but for the tender regard for skittish horses. It seems in many instances that the rights and interests of the human family are sacrificed so that horses may control the highways. In some parts of the world the bicycle is coming to be regarded as the poor man's horse, and its use enables many workmen to keep their families outside of crowded cities. We believe the artisans of the rising cities who may wish to ride home on a bicycle ought to receive some consideration from legislators.

An apparatus for operating fog whistles has been designed by Messrs. Durham, Churchill & Co., of 23 Leadenhall street, London. It is a small and compact machine, consisting of an hydraulic cylinder fitted with a piston and two small regulating valves, one for a quick motion and the other for a slow motion, both variable as desired. The piston in the hydraulic cylinder is operated by a small steam cylinder, in the same axial line. The slide valve operating this small steam cylinder is worked internally and automatically, so that there are no outside parts to be tampered with, or to get damaged, or out of order, by dirt or exposure to weather. There is a second steam cylinder, the piston rod of which connects directly by means of a cord to the fog whistle; it is only necessary to turn on steam and the machine starts. The duration of the sounds, and the silent intervals, are adjustable to a second, by means of the two small valves in the hydraulic cylinder. The only present recognized means of preventing collisions at sea during fog is by sounding the steam whistle, horn, or syren, at stated intervals, to warn ships in close proximity; and it has long been felt that this, which is a life-saving precaution, ought to be done automatically, as it is of great importance that the intervals and durations of the sounds should be regular, and not dependent on a sleepy hand, who may miss giving the required signal at the critical moment, and too late to be acted upon.—*Iron.*

The Indicator Diagram.

By F. F. Hemenway.

INITIAL EXPANSION.

The greatest economy in the use of steam in the steam engine being, broadly speaking, when the terminal pressure is lowest compared with the mean effective pressure, it follows that a fall of pressure in the cylinder previous to cut-off, usually called initial expansion, represents a loss when occurring in an automatic cut-off engine, because it makes the cut-off occur later than it otherwise would, increasing to a corresponding extent the terminal pressure. Hence, in this type of engine the effort is made to provide for a steam line as straight and as near boiler pressure as practicable without sacrificing too much in some other direction to obtain it. There is undoubtedly a point in all ordinarily constructed engines beyond which it is the reverse of economical to go in this direction; a point somewhere short of boiler pressure in the cylinder; and short of an absolutely straight steam line. Just how far it represents economy in the use of steam to go in the direction of a perfect steam line depends upon a variety of circumstances. Small valves do not consume so much of the power of the engine in their operation as larger ones (of the same kind), and as there is inevitably some leakage it is naturally greater where the ports are long than where they are short. It is also understood that a balanced valve moves easier than an unbalanced one, all of which is entitled to consideration in determining what the character of the steam line should be.

But while it is true that initial expansion, to any great extent, represents a loss of economy in the instance of an engine in which the governor operates to vary the point of cut-off, it is equally true that when the cut-off is fixed and the speed controlled by means of a throttling governor, initial expansion usually represents gain, sometimes in a marked degree. This is because it then has the effect of bringing about lower terminal pressure for a given mean effective pressure.

While initial expansion is, perhaps, properly enough called throttling, the distinction should be sharply made between throttling that results only in reducing the initial pressure, and that which provides for a gradual fall in the pressure from that nearly equal to boiler pressure to a point materially lower at cut-off.

The diagram, Fig. 15 (in full lines), shows a fair amount of initial expansion, and will illustrate the gain brought about by it, which may be more or less, according to circumstances. It is from a 12″x20″ engine, running at 90 revolutions, valve adjusted to cut-off at 11″, or at c on the diagram. The boiler pressure was 50 pounds, 39 pounds of which is realized in the cylinder at the beginning of the stroke, the pressure falling from that pressure at b, to 22 pounds at c, by initial expansion, and then by regular expansion to a terminal pressure, t, of 24 pounds absolute. The gain by initial expansion may be determined by comparing the actual diagram with the one plotted in dotted lines, both diagrams representing equal work. In the latter the pressure remains constant from b' to c', the initial pressure being 27 lbs., or that required with the straight steam line to make the mean effective pressure equal that of the actual diagram. Since the mean effective pressures of the two diagrams are the same, the weight of steam calculated at t and at t' will represent relative economy. As the quantity in cubic feet per stroke or per hour, will be the same in one case as in the other, it is only necessary to consider the difference in weight of a cubic foot at pressures t and t', which difference will be the gain. The pressure (absolute) at t is 24 lbs., and the weight per cubic foot at that pressure .0579 lb. At t' the pressure is 27 lbs., weight of a cubic foot .0648 lb.; difference, .0061 lb., or about 11 per cent., so it is safe to conclude that initial expansion represents a gain, in this instance, of say 10 per cent.

The steam lines of diagrams from engines in which the speed is controlled by throttling

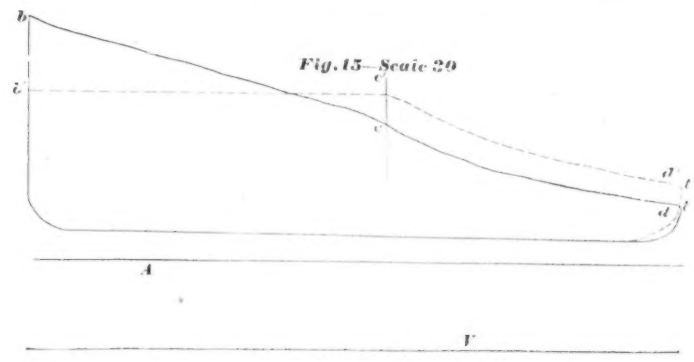


Fig. 15—Scale 20

will be of a variety of forms, according to existing conditions and the construction of the engine. There is quite as much difference in the economy of such engines, whether fitted with separate expansion valves or not, as there is between different automatic cut-off engines, and it is just as readily determined by the use of the indicator, notwithstanding which the indicator is seldom applied to this class of steam engines. Its intelligent use, changing the construction in accordance with what was learned from its indications, would result in as much gain in efficiency, comparatively, as has been the case in the instance of the automatic cut-off engine.

Locomotive Engine Running—The Valve Motion.

By Angus Sinclair.

EARLY REVERSING MOTIONS.

In the engineering practice of the world, before the locomotive and marine engines came into use, there was no need for devices to make engines rotate in more than one direction. When the need for a reversible engine first arose, it was met by very crude appliances. Locomotives were kept at work, earning money for their owners, which were reversed by the man in charge stopping the engine, and by means of a wrench changing the position of the eccentric by hand. A decided improvement on the wrench was the movable eccentric, which was held in forward or back gear by stops, the operation of reversing being done by a treadle or other attachment located near the engineer's position. A serious objection to this form of reversing gear was, that the abrasion of work enlarged the slot ends and wore out the stops, leading to inaccuracy and frequent breakage. A somewhat better form of reversing motion was a fixed eccentric, with the means at the end of the eccentric rod for engaging with the top or bottom of a rocker shaft, which operated the valve stem. This was the form of reversing motion used on the early Baldwin engines. Numerous other appliances, more or less defective, were experimented with before the double fixed eccentrics were introduced. Till the link was applied to valve motion the double eccentrics—an American invention—were the most important improvement that had been made on the locomotive valve motion since the incipiency of the engine. The V hook, in connection with the double eccentrics, made a fair reversing motion in comparison to anything that had preceded it. The objection to the hook was that, when the necessity arose for reversing the engine while in motion, much difficulty was experienced in getting the hook to catch the pin. As a simple, prompt and certain reversing motion, the link was readily acknowledged to be far superior to anything that had previously been tried.

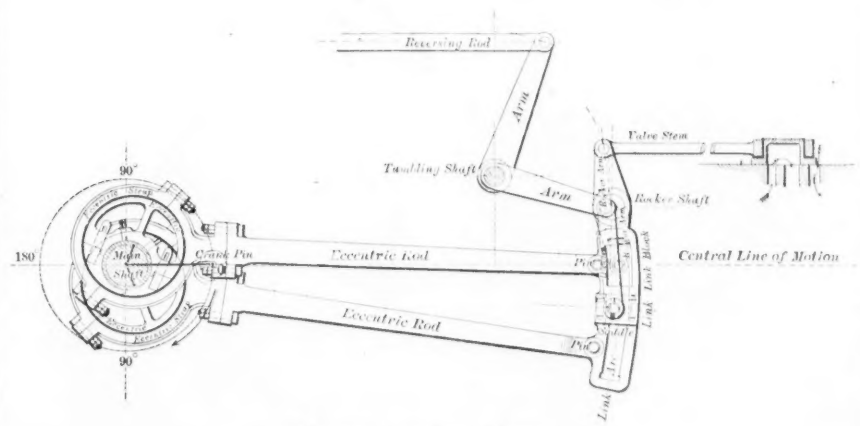


Diagram of Link Motion.

INVENTION OF THE LINK.

There is no doubt but the link was first applied to a steam engine by William T. James, of New York, a most ingenious mechanic, who also invented the double eccentrics. James experimented a great deal about the period from 1830 to 1840 with steam carriages for common roads, and it was in this connection that he invented the link. His work having proved a commercial failure, the improvements on the valve motion were not recognized at the time, although the probability is that Long, who started the Norris Locomotive Works of Philadelphia, and brought out the double eccentrics upon the locomotives built there, was indebted to James for the idea of a separate eccentric for each direction of engine movement.

The credit of inventing the ordinary shifting link is due to William Howe, of Newcastle, England. This inventor was a pattern-maker in the works of Robert Stephenson & Co., and he invented the link in practically its present form in 1842. The idea of Howe was to get out an improved reversing motion, and he made a pencil sketch of the link to explain his views to his employers. The superintendent of the works was favorably disposed to the invention, and ordered Howe to make a pattern of the motion, which was done, and this was submitted to Stephenson, who approved of the link, and directed that one should be tried on a locomotive. Although Stephenson gave Howe the means of applying his invention, he does not seem to have perceived its actual value, for the link was not patented, and Stephenson never failed to patent any device which he thought worth protecting.

The link motion was applied to a locomotive constructed for the Midland Railway Company, and proved a success from the day it was put on. Seeing how satisfactorily the invention worked, Robert Stephenson paid Howe twenty guineas (one hundred and five dollars) for the device, and adopted the link as the valve gear for his locomotives. This is how the shifting link comes to be called the "Stephenson link," and the credit for this invention was not extravagantly paid for.

The capability which the link possesses of varying the steam admission and release did not appear to be understood by the inventor, nor was the mechanical world aware for some time after the link was brought into use that it could be employed to adjust the inequality of steam distribution, due to the angularity of the connecting rod.

CONSTRUCTION OF THE SHIFTING LINK.

As usually constructed for American locomotives the link is a slotted block curved to the arc of a circle, with a radius about equal to the distance between the center of the driving axle and the center of the rocker pin. The general plan of the link motion is shown in the figure. Fitted to slide in the link slot is the block which encircles the rocker pin. The eccentric rods are pinned to the back of the link, the forward eccentric rod connecting with the top and the back up eccentric rod with the bottom of the link. Bolted to the side, and near the middle of the link is the saddle, which holds the stud to which the hanger is attached, this, in its turn, connecting with the lifting arm, which is operated by the reversing rod that enables the engineer to place the link in any desired position.

ACTION OF THE LINK.

Regarded in its simplest form the action of the link in full gear is the same upon the valve movement as a single eccentric. When the motion is working, as in the figure, with the eccentric rod pin in line with the rocker pin, it will be perceived that the movement cannot differ much from what it would be were the eccentric rod attached to the rocker. Here the forward eccentric appears as controlling the movement of the valve. Putting the link in back motion brings the end of the backing eccentric rod opposite the rocker pin, the effect being that the back up eccentric then operates the valve. When the link block is shifted toward the center of the link, the horizontal travel of the rocker pin is decreased; consequently, the travel of the valve is reduced, for with ordinary engines the travel of the valve in full gear equals the throw of the eccentrics, the top and bottom rocker arm being of the same length. The motion transmitted from the eccentrics and their means of connection with the link make the latter swing as if it were pivoted on a center, which had a horizontal movement equal to the lap and lead of the valve. The extremities of the link, or rather the points opposite the eccentric rods, swing a distance equal to the full throw of the eccentric. The variation of valve travel that can be effected by the link is from that of the eccentric throw in full gear down to a distance in mid gear, which agrees with the extent of lap and lead. The method of obtaining these various degrees of travel is by moving the link so that the block which encircles the rocker pin shall approach the middle of the link.

When an engine is run with the lever in the center notch, the supply of steam is admitted by the lead opening alone. In full gear the eccentric, whose rod end is in line with the rocker pin, exerts almost exclusive control over the valve movement; but, as the link block gets hooked towards the center, it comes to some extent under the influence of both eccentrics.

A thoughtful examination of the figure will throw light on the reason why the proper position of a slipped eccentric can be determined by the other eccentric when the engine is on the center. In the cut the crank-pin is represented on the forward center, and in that position the eccentric centers are both an equal distance in advance of the main shaft center. It will be evident now that the valve must occupy practically the same position for forward or back gear, as each of the eccentric rods reach the same distance forward. Putting the motion in back gear would bring the back up eccentric rod pin to the position now occupied by the pin belonging to the forward eccentric rod.

A correspondent in *Engineering* refers to the small amount of power absorbed in engine and pump friction in the published tests of American pumping engines, and hints that the reason may be due to the internally-packed pump plungers, by which leakage cannot be readily detected. Equal results, he says, are never reached in England, and thinks there is something of the "white elephant" about them.

LETTERS FROM PRACTICAL MEN.

Belts to Connect Shafts at Different Angles and in Different Planes.

Editor American Machinist:

It is often necessary in shop practice to locate line and other shafts at angles with each other, and as gearing is more or less noisy, many resort to the use of quarter twist belts. To those who are contemplating the use of such belts, I would say *don't*. I speak from experience, which was this: A number of years since I had charge of a shop where the ground floor was used for iron working tools, and the line shaft run lengthwise of the building. The second floor was used for wood working tools, etc., and it was thought best to run the line across the shop so as to accommodate the planers and saws.

To get power to this shaft a quarter twist belt was used, connecting a 48″ pulley on the line below to a 15″ on shaft above. The belt used was 10″ wide, and the result was that the belt soon stretched on the edge, and only gave the power that a 5″ belt should have given. The operation will be readily seen by referring to Fig. 1, where it will be noticed that the belt passes around the pulley *B*, all right until it reaches the point *a*, and would continue to the point *b*, but for the pulley *A*, which seeks to draw it in line with itself, and of course slides the belt edgewise on the pulley and brings all the draft on one of its edges. This is repeated at *c* and *d*. If we could estimate the amount of power expended in sliding the belt on the pulley, as shown, we would then know the amount of endwise friction on both shafts. This would, of course, be less if the shafts were a long distance apart.

The plan which I substituted, and which gave perfect satisfaction in every particular, will be seen in Fig. 2. Here the pulley *B*, instead of being over one side of *A*, is moved on the shaft any convenient distance and (as will be shown farther on) the shaft itself can be placed where most convenient. Then place the corner or idler pulleys *C′ C″* so that their circumferences shall coincide with the center of the circumferences of the two pulleys, with the shafts of *C′ C″* at right angles to a line drawn from the rim of *B* to *C′* and *C″* respectively, as will be seen more clearly in Figs. 4, 5 and 6.

Now, although we have added the friction of two pulleys, we have saved the endwise friction on the shafts, and the sliding friction of the belt, and secured the extra adhesion of the latter, and more than this the belt draws square and true.

That the reader who is unfamiliar with the subject may get a more thorough insight into the system of irregular belting, I will give a few sketches where the shafts are at different angles, and the pulleys are of the same and different sizes, etc. The opinion is quite general that shafting must be parallel, or at right angles, to be connected successfully, but this is not the case, for if it were necessary to run a shaft up the stairway of a factory and shafts on each of the different floors connected with it, there would be no difficulty in doing it.

Referring to Fig. 3, pulleys *A* and *B* are of the same size, and the shafts at right angles, and pulleys *C′ C″* are on the same shaft, the center of the rims in line with *A*, and the opposite side of rims in line with the center of *B*.

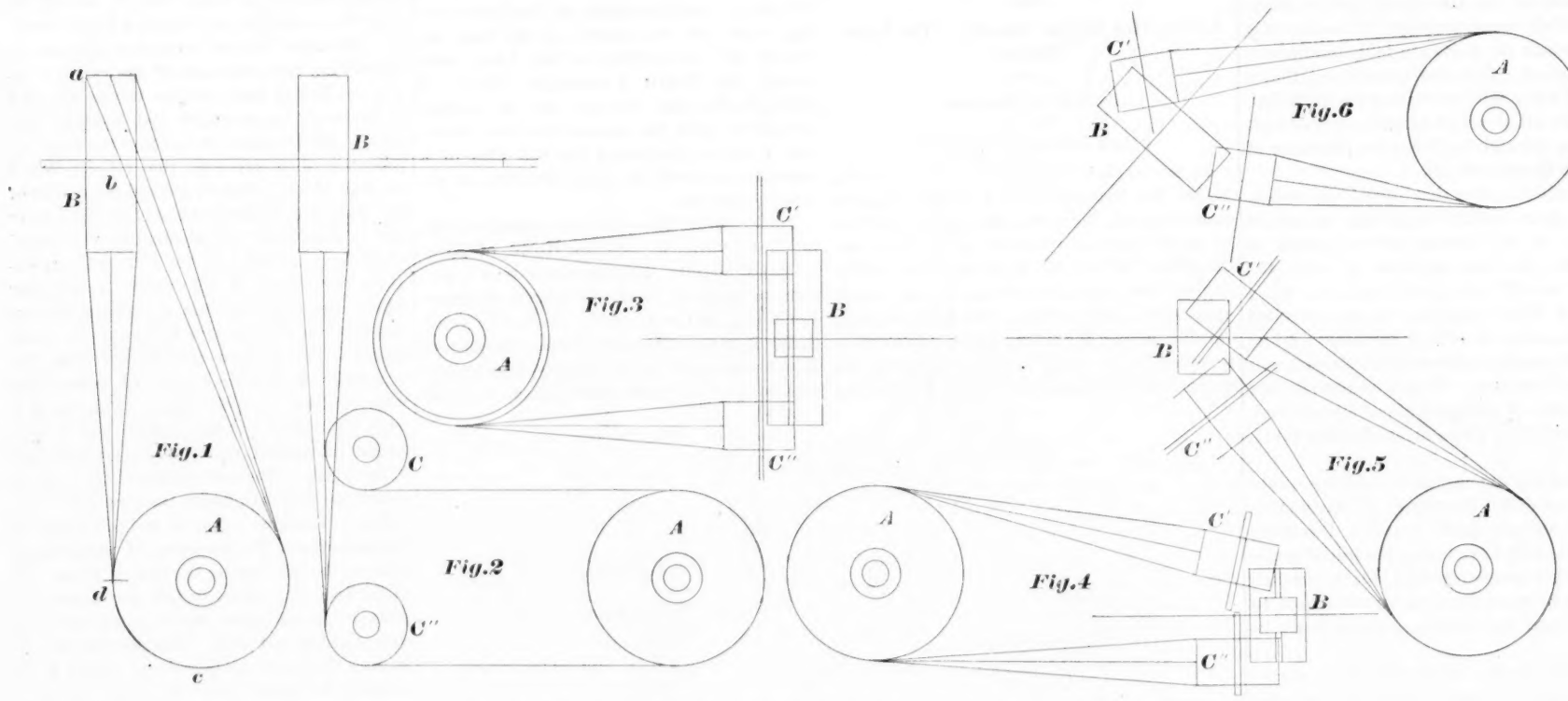
In Fig. 4 there are other conditions. There *A* is larger than *B*, the shaft on which *B* is is lower than the other, so that while *C″* stands vertically *C′* is turned at right angles to the belt coming from *A*.

In Fig. 5, *B* is above *A*, but the shafts are at right angles and *C′*, *C″* are placed at different angles although complying with the same general law given above.

In Fig. 6, the shafts are at different angles, and it will still be seen that although *C′ C″* are quite differently located, the same rule is applied.

Now in studying all the figures it will be noticed that one of the idlers acts as a leader to direct the belt to one of the pulleys, while the other does the same for the other pulley. It will also be noted that if properly adjusted it makes no difference which way the shaft may turn. If necessary to change the motion of one of the shafts by the use of a cross belt, the idlers would have to be set at right angles to a line drawn from the rim of *A* to the opposite side of *B*.

H. Reynolds.



Belts to Connect Shafts at Different Angles and in Different Planes.

Hot Eccentrics.

Editor American Machinist:

The most troublesome of hot bearings around a locomotive are hot eccentrics. They present very large surfaces for friction, and are, as a general thing, fitted with the most primitive of lubricating devices; merely a hole in the strap, filled with waste, wool, or curled hair. Some engineers use two or three of these feeders; when they get hot, the runner will always put tallow in these oil holes, if he has got it—animal fat will cool off a heated bearing when mineral oils fail—it is heavier, feeds slower, and wears longer. When there is a long, fast run to make, you will see the engineer put a little tallow on the eccentrics, pins, and crosshead. In the eccentric strap this tallow is hard, but when the strap gets warm the tallow melts and commences to feed. If the strap cools off, or the end of the run is reached before *all* the tallow is gone, it gets hard in the oil-hole and feeder, and there is no more oil for that eccentric until it is all cleaned out and new feeders put in; or the strap gets hot enough on the next trip to remelt the tallow.

Now, I have been there. Cæsar's great ghost! did any reader ever run a 35-ton, consolidated, narrow-gauge engine, and have hot eccentrics? A search warrant could not get under one of these engines, unless the edges were trimmed off.

Now here is a kink, which may not be new to all; I think it will be to many. I take a piece of copper or tin pipe, about one inch longer than hole in strap. I cut two or three half-inch slots in one end and turn one or two strips out at right angles to pipe; this is at the bottom, and strips are to keep it from working out of oil hole. I turn this upside down, holding one finger over top end and fill with tallow, and allow to cool. I put this burred end down in oil hole, and pack feeder around it. You can oil as ever, the feeder does not stop up; and when the strap gets hot the tallow is there first, feeds as long as it is hot, and stops when it gets cool. You can refill without taking pipe out.

Talk of handiness on locomotives. Would it be a poor suggestion if I recommend that eccentric straps have *two* oil holes instead of one, and the small one be filled with tallow, which would stay cold except in case of heated strap? This would cost about thirty-five cents per engine, and if used once in six months would save much delay and expense to the companies who own them, and untold quantities of profanity to the men who run them. A piece of sperm candle in tallow will make it stay hard in hot climates, or slight warmth.

Gillcrank.

Lack of Waste and Failure—Twist Drill Shanks—Exhaust Ports.

Editor American Machinist:

In January, 1882, my employers failed; the doors of the establishment are still closed. In February, 1883, my employers failed; doors still closed per last accounts. In March, 1884, my employer failed; doors now open. The assignee conducts the business; and if he is not interrupted he will, with plenty of work at good prices, make some money, probably. I did not expect to be "taken in"—or, more appropriately, "let out"—in this manner three times in 26 months. I feel sure, though, that I will not meet with such ill-fortune again very soon.

I have learned something by the experience, and will let the boys know it, for their benefit, perhaps. A little while before the first failure, cotton waste became a scarce article about the shop, and a few days previous to the event none could be had at all. The second failure occurred hundreds of miles from the first, and, although waste was plenty a few weeks before the collapse, those hands who had any at the last moment were those who had suspected a scarcity, and by shrewdness or otherwise had laid in a supply. The third failure took place a long distance from either of the preceding ones, and it is a significant fact that the waste sacks at the time of the assignment were empty. Remembering that these failures have occurred 13 months apart, I will take warning, and early in April, 1885, will make searching inquiry in regard to the amount of cotton waste on hand. If there is an abundant supply I will feel easy, but if there is none I will look out. * * *

Since I have made the acquaintance of J. J. Kirby and a few of his excellent ideas, I have often wondered why those inventors who have done so much to improve the twist drill, ever decided to drive it by the small end instead of by the large end of the shank. Everybody knows what a twist drill shank is like. But Mr. Kirby's shank has a tapering section, like the Morse taper, and, unlike the Morse shank, is provided with a square section at the large end of the taper. The taper shank will hold the drill in line the same as the Morse drill; but the power is applied to the square, instead of to the comparatively frail flat extension on the small end of the shank. A Morse socket, having the open end cut out square, will drive either the Morse shank or the Kirby shank. The square on the drill must be a loose fit in the socket, otherwise a tight fit in the taper cannot be assured. The ordinary shank may be good enough to use in "fine haired" shops, but the Kirby shank is just as good; and in jobbing shops, where sometimes work must be pushed as hard as men and tools can endure, it is far superior. * * *

Why do most builders of common slide valve engines take great pains to square up the exhaust port? If the port is ample in area, the diagram will be the same whether the edges are rough and crooked, or smooth and straight. Might as well bore out the other end of the exhaust pipe.

J. E. McConnell.

The Black Line Process of Copying Drawings.

Editor American Machinist:

In regard to your inquiry about the black line process, it is very elaborate as compared with blue printing, and requires considerable skill to get good results. Below is a practical description:

To print 36 plates, 24″×36″, would require

2	gals.	collodion, @ $2.60	$5.20
2	"	sensitizer, @ .20	.40
1	"	gelatine, @ .80	.80
24	"	water	..
		Total	$6 40

Any good, smooth, white paper, bond paper, tracing cloth or paper, or bristol board, may be used. (Egg shell or tinted papers are of no use.)

Clean a glass the size of drawing, float it

with collodion, take it to dark room and coat with sensitizer, using a soft brush; dry over a gas stove about two minutes. Place glass in a frame under the drawing to be copied, and expose to bright sunlight from forty-five seconds to four minutes, according to opaqueness of negative. Remove it to dark room and dust the glass with lamp-black—the lamp-black will stick to the lines only—float again with thin collodion. Wet tracing cloth or paper (on which print is to be made) with water containing gelatine, and lay the wet paper (or cloth) on the glass, and rub down flat with a straight edge. Dry for about an hour, then peel it off the glass by starting at one corner. The print is perfectly waterproof, and can be mounted and washed.

When putting the negative on the sensitive plate, place the ink lines next the plate. After cleaning glass thoroughly, rub it with powdered French chalk, and the collodion film will strip off easier. A. G. Brown.

Westinghouse Machine Co., Pittsburg, Pa.

Cheap Lubricating Mixtures.

Editor American Machinist:

An inference to be drawn from the exposition of the Fink lubricant, in a late number of your journal, is that the American Machinist and other serials of its kind demand a wider circulation.

It seems incredible that so many prominent firms should be deceived by this oil "dilution trick," which is more than twenty years old.

By means of alkalies, the oil and water are converted into soap—thin soap water of good quality, but commercially not worth more than 15 cents a gallon when made from the usual materials.

I think it was in 1861, an oil fiend visited Columbus, Ohio, and succeeded in selling to several firms—the Ohio Tool Company among the number—a recipe for making this mixture. Two barrels of soap were made from one of oil, and the result was a loss of the oil, which could not be cleansed after the water had separated.

Mr. J. R. Maxwell, the well-known hydraulic engineer, once made a remark about "unguents" that covers the whole ground, including the soap of Fink *et al.* He said: "I have noticed that the commercial value of oils, as well as their lubricating value, is directly *as the amount of grease they contain.*"

How nearly this applies in the case of the patent (?) lubricant, your victimized correspondents will be prepared to judge.

I think in many cases a light lubricant, such as the one complained of, will do very well if it can be "kept together," and would certainly be cheap at its true value of ten to fifteen cents a gallon.

The recipe of a good chemist for preparing the mixture would be more reliable, and perhaps cheaper, than that of Mr. Fink.

J. Richards.

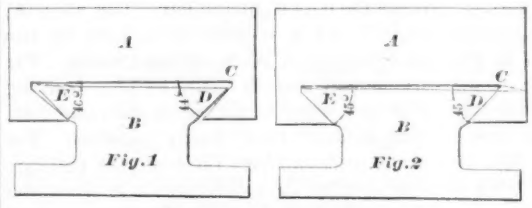
San Francisco, March 20, 1884.

Centrifugal Force Discussion.

Editor American Machinist:

Mr. Trautwine's criticisms of Mr. Porter's *advanced* theories on forces controlling revolving wheels are greatly in error. The conditions wherein the force of steam acting upon the shell of a cylindrical boiler, and the forces exerted upon the rim of a revolving wheel tending to explode and reduce each to fragments, are analagous only insomuch that the strain in each causes the particles of iron, of which they are composed, to separate. But when separated the pieces which composed the shell of the boiler will fly off in radial lines, if the shell was a perfect circle, equal in section, and the metal homogeneous; and the pieces which composed the rim of the revolving wheel will be projected in tangential lines or paths. Therefore, Mr. Porter's statements seem to be correct, while the definition as given in the "Civil Engineer's Pocket-Book," viz., "The force with which a body, while revolving round a center, tends to fly off in a radius," must of necessity be incorrrect.

The illustration of Mr. Trautwine in support of his theory is very ingenious, but will not bear analyzing. The blow struck by cue number one is given too soon, because the



Planer Graduation.

ball at that point and instant of time does not require either a blow or guide to keep it in position—*i. e.*, at a distance from the center equal to radius.

After the ball has passed that point, the blow or restraining force must be exerted; and then, if the force is at right angles to the path of the ball, it will not be a radial line. Moreover, if a blow should be given in a radial line at the aforesaid point, its tendency would be to stop the motion of the wheel abruptly, because it would be delivered at an angle less than 90°.

Richard Lavery,
Superintendent City Point Works,
South Boston, Mass.

Planer Graduations and Graduated Tools.

Editor American Machinist:

E. W. Johnson, in your issue of March 29, is inclined to lay the fault of planers to the fact that the cross-head gets out of line; that is, that one side gets lower than the other, rather than to the graduations. Now, if the cross-head of Mr. Johnson's planer is raised at one side, as indicated at *C*, to the extent of 1° (I hope there is not a planer in America so bad), and he attempts to plane his work at an angle of 45° by the graduations on the head, he will find the angle *D* will be 44°, and the angle *E* 46° from the platen, as indicated in Fig. 1, and if the piece *A* is already planed at 45°, the fit of *B* to *A* will be something as indicated in Fig. 1. If he trust to the index of his tool, he may plane his angles 45°, but the cross-head still being out of truth the fit will be as in Fig. 2—not much of an improvement. With the cross-head out of truth with the platen, a fit cannot be had by the use of his tool. F. C. D.

Steam Pipe Diameter.

Editor American Machinist:

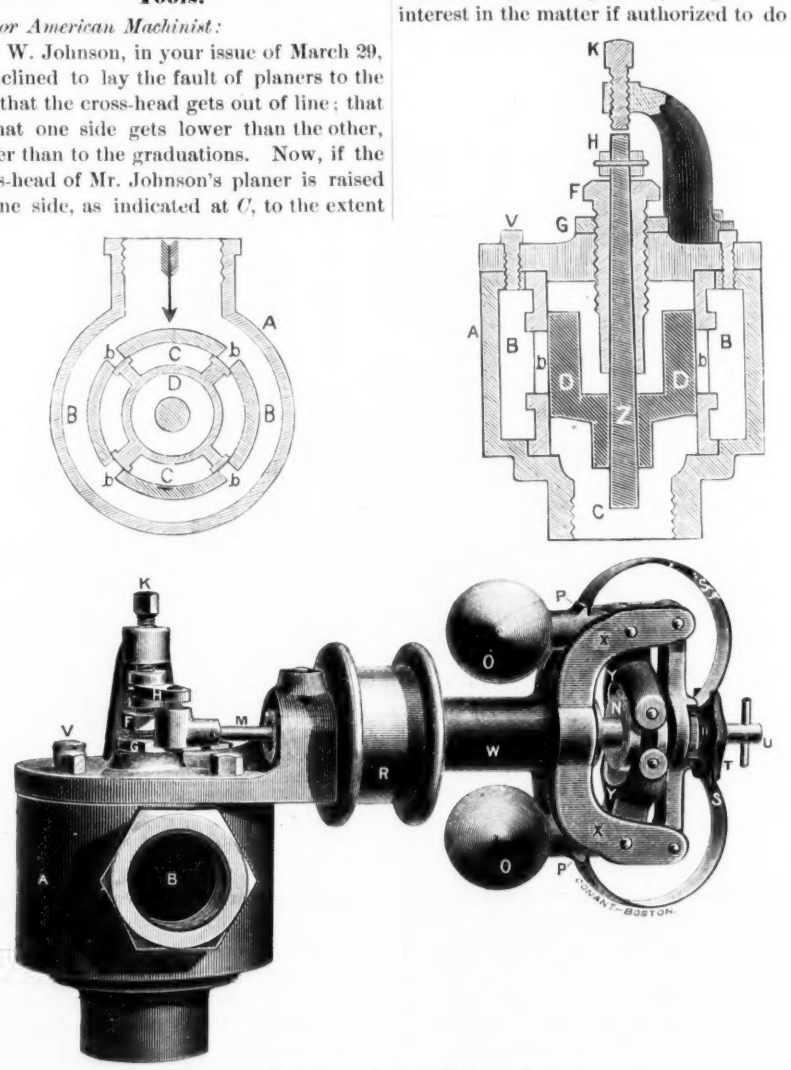
In your issue of April 5 you state that a well-known engineer has found by experiment that he could supply sufficient steam to drive an engine of 200 horse-power with a one and one-half inch steam pipe, steam at 90 lbs. pressure, and a back pressure of 20 lbs. You further state such experiments are of interest if they do overturn theory. Now, I want to ask, for the benefit of your readers and myself, if the sizes of steam pipes, or the flow of steam and water through a pipe at a given head or pressure, were originally determined by practice or by theory. Hitherto I had always supposed that all formulas relating to the subject had been determined by the most elaborate experiments, so that I am induced to believe that no such gross blunders have been made on the size of pipes necessary to supply a given amount of steam at a given pressure.

Would it not be well and of interest if your correspondent would kindly give us the full particulars of his experiment—size of cylinder, ports, piston velocity, and, if possible, a card from each end.

Further, I have no doubt, if he feels so sure of the correct results of his experiments, he will not withhold the name of one who has made such a valuable discovery.

Wm. B. Yates.

[The particulars which we gave at the time referred to were from a private letter, and hence names were withheld. We should, of course, be glad to give anything of further interest in the matter if authorized to do so. We did not state that the steam passed through a one and one-half inch *pipe*, but "through a hole 1½" diameter"—a very important difference. We are not aware of any very elaborate experiments to determine the quantities of steam that will pass through pipes of different diameters and lengths and under different conditions, but do know that engineers differ widely in their opinions on the subject. As, perhaps, of some interest in this connection, we recall an instance in which William Coutie & Son erected a compound engine, cylinders 11" and 18"x18", and, in order to complete the connection hastily, so as to run the engine light, a piece of ¾" pipe was put in from the steam pipe proper to the steam chest, the length being, perhaps, two or two and one-half feet—perhaps more. It operated so satisfactorily that the work was put on and driven in this way for some months. So far as we know, the power was never measured, but from the machines (wood-working) driven it was variously estimated by those acquainted with the requirements of such machines to be at times from 40 to 50 horse-power. The steam pressure was 60 lbs.; speed, 80 revolutions per minute. We have no doubt whatever that steam enough would pass through an opening 1½" diameter to do, under the circumstances named, 200 horse-power of work. In fact, we believe enough would pass through a still smaller opening. It was not claimed that a "discovery" had been made, or that it was good economy to restrict the passage to the extent mentioned, or to any extent.]



Wright's Improved Steam Engine Governor.

"The Bursting Strain in Revolving Wheels."

Editor American Machinist:

The strain per square inch of pulley-rim section is one-tenth of the square of velocity in feet per second, nearly.

As determined by Mr. Porter's formula (American Machinist, February 16 and 23), the strain due to running a 20-foot wheel 100 revolutions per minute = 1,085 lbs. per square inch, and by the above rule ($V^2 .10$) the strain figures 1,096 lbs. per square inch of section. A 5-foot wheel, at 200 revolutions, has, by Mr. Porter's rule, a strain of, say, 271 lbs. per square inch, and by rule above given about 273 lbs.—a difference too slight to quarrel over, considering the fluctuation in strength in different castings, or even in different parts of the same casting.

Knowing the belt speed, it is, in many cases, quite possible to determine the strain by "mental 'rithmetic." The constant .1 has been taken, instead of that actually due to cast-iron, as it allows us to point off one figure at the right of the V^2 value, instead of making the usual division.

Mathias Beck.

Wright's Improved Steam Engine Governor.

This governor has several peculiar features, one of which, the avoidance of the use of packing, will be appreciated.

It is driven by a pulley, *R*, attached to the revolving ball standard, *W*. This standard has two slotted arms, *X*, *X*, in which the ball-arms are pivoted, and which also support the cross-bar. The cross-bar is a support for the flat bow springs, *S*, *S*, which control the action of the balls by pressing them inward, their tension being regulated by the adjusting screw, *U*, which presses the plate, *T*, upon them, and so varies their pressure upon the arms at the points, *P*, *P*, giving a wide range of adjustment without lessening the full volume of steam when the full power of the engine is required. As the weight of the balls is not depended on, light balls are used, running at a high speed, making the governor very sensitive and enabling it to run in a horizontal position, thus avoiding the use of a driving shaft and gears, and making it very compact as well as noiseless.

In the forked ends, *Y*, *Y*, of the ball levers are loosely pivoted blocks, which revolve in a groove in the head, *N*, fastened to the rod, *M*. As the balls are forced outward and inward, the rod *M* is moved downward and upward, closing or opening the valve by means of the lever, *H*, which is attached to the valve stem.

The valve stem is slightly tapered, and fits a correspondingly tapered seat in the screw, *F*. The pressure of the steam causes its upper end to press upon the screw, *K*, by which it is so nicely adjusted to its seat as to prevent both friction and the escape of steam, making a steam-tight joint without packing. The annoyance of frequent packing is thus avoided. After the screw is once properly set, it will need no further attention.

This arrangement of the valve stem, together with the quick speed of the balls and their great freedom of action consequent upon the arrangement of the springs, and their indirect action upon the valve through the lever, *H*, make the governor very sensitive to slight variations of speed.

It is manufactured by the Wright Machine Company, Worcester, Mass.

Engineers of the New York Central Railroad are now forbidden to drink intoxicating beverages off as well as on duty. Most of railroads are moving in this direction, the fact being recognized that drinking at any time unfits a man to run a locomotive.

Engine Pattern Work.

By Isaac Whitehead.

There is more than ordinary skill and ingenuity required in this class of pattern work, because of the greater range of heavy and light dry sand, green sand, and core work embraced. The cylinder is the first casting required, because of the greater amount of machine work required upon it compared to the rest of the castings. It ranks as the most important, owing to its cost and large wearing surfaces. All steam cylinders should be cast on end, because of the required cleanliness of the metal in the bore. I have heard considerable of their being cast on their side and yet be clean, but have not seen it done with any uniform success. I have seen thousands of dollars spent in fruitless attempts to that end, with which I have been personally connected. Even where you may be to a sufficient degree successful in getting the bore reasonably clean, the texture of the iron must be closer on the side of the cylinder which is down in the mould than on the other side, which is very objectionable. With ordinary foundry appliances, all cylinders that exceed 16″ bore should be struck up, because:

1. First cost of strikes, etc., is less in pattern work, and does more perfect work.

2. The great cost of iron flasks necessary when a pattern is used.

3. The constant changes that are required to suit the condition of each case are made with less cost when struck than in a pattern.

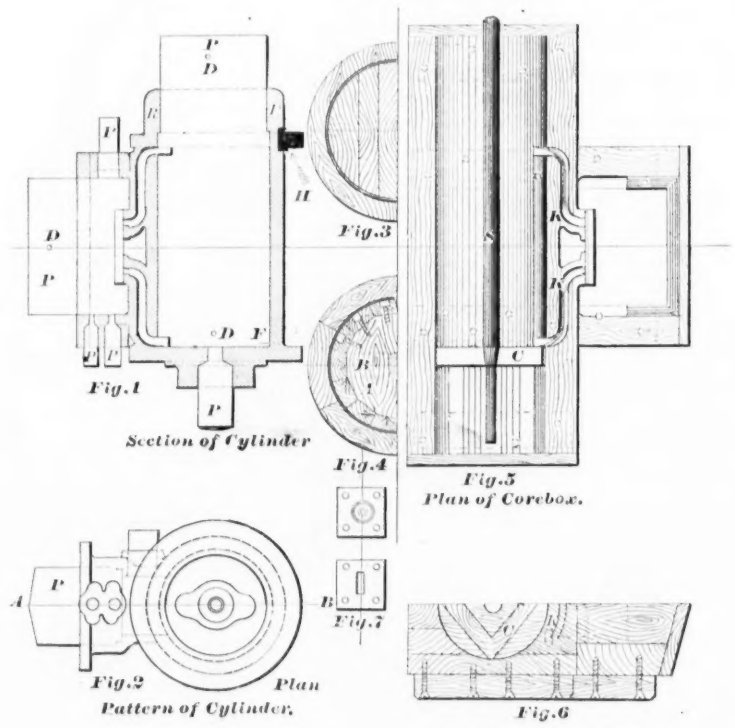
For an example of cylinder work I will take a common small cylinder, which, with little variation, is so generally used in applying steam to special machines.

The cuts, Figs. 1 and 2, show a cylinder with one head and the steam chest cast on. This style is very largely adopted now because of its cheapness, saving the making of the two joints of the head and loose chest. The easiest way to mould this will be to part it in the center at *A B;* thus we will have a level parting with no loose pieces. To cast it on end, the moulder will up-end his flask after the cores and moulds are fixed and closed. To insure a cleaner bore, the riser *R* is added to the top end of the cylinder, so that, as the hot metal rises in the mould it will float the impurities to this part, which will be cut off in the machine shop on facing the flange. Ordinarily the joining of the riser is made the same size as the thickness of the cylinder, and the riser from 4″ to 8″ long. Next lay off the extension for the prints, marked *P*. The length of prints are determined by the weight of core to be balanced. Steam chest prints should bevel from the center about 1″ to the foot, so that, when the cope is lowered upon the core the prints will clear the core until it is closed. This should be done in all cases where the parting is below the top of the print, as in this case. Half a core-box is all that is needed; so to make both half cores alike I bevel the lower half of print as well as the upper one. Next allow and lay off your finish. Supposing this to be a 10″ cylinder, I would allow $\frac{1}{4}$″ on the surface of the valve face and flange next to the riser, and $\frac{1}{8}$″ on surface of bore, lower flange, steam chest flange and stuffing boxes. To allow $\frac{1}{10}$″ shrinkage is the best for this class of work, according to my observation.

In constructing a cylinder pattern of 8″ bore and under, it is best glued up as shown in Fig. 3; and when larger, they should be lagged up like sample shown in Fig. 4. In glueing up, be careful to turn the heart side of the board outside, as shown in Fig. 3, and make it long enough to turn up the prints solid with the drum. The flanges are got out separate, the grain running the opposite way, and thick enough to turn out the hollow shown at *H*, Fig. 1. They are let in by a turned groove about $\frac{1}{4}$″ deep, screwed fast from the inside of the parting, and turned up with the body of cylinder.

In the case of lagging up, as shown by Fig. 4, the length of the drum would be, from inside of flange of head at *F*, Fig. 1, to top of riser. The head and print would be made separate, and screwed on from the inside. By this means we get a smoother surface on the head end to draw out of the sand than if the end of lags came through. Flanges of the larger size should be built up in segments of two layers, as shown in Fig. 4. The bearings *A* should be near enough together to avoid any spring in the lags, while the rib *B* is set in between them to brace the drum endways. The lags are jointed, glued, and screwed, the head of screws being let in sufficiently to allow wooden plugs to be glued into the counter-sink. The grain should be the same way as the lags. The two halves are jointed together, and the holes for dowel pins, at *D*, Fig. 1, are bored through the one half into the other while they are clamped together in position. The further apart you place your dowel pins, the more serviceable they become, this being limited by the necessary strength outside the dowel to hold it firmly. A center plate, as shown in Fig. 7, is screwed on the end, which is made to fit the lathe, one end having a counter-sunk center, while the other is made to fit the lathe chuck. These plates have center lines carefully marked upon them, these lines being set to the center lines of pattern. When the cylinder is too small to use these plates, the wood is left 3″ longer at each end, where a screw is counter-sunk, screwing the halves together. The steam chest is glued up solid with the print, and first planed down to the shape and size of body, then fitted to the cylinder and screwed from the inside. Side draft should be allowed on all square surfaces, of about $\frac{1}{8}$″ to the foot. Two dowel pins are put through the steam chest portion the same size as in the cylinder. These pins should be made to work free, fitting the hole for about $\frac{1}{8}$″, and then rounded over. When there is much wear expected on them, iron dowel plates let in level with the joint are used.

The old style of arranging the cores is by making the main core, port cores, and steam-chest core separate, with a separate box. About eight years ago I arranged the box as shown, wherein the whole of the cores are made in one, thus avoiding a lot of separate pieces, while the moulder has no setting of cores, but one core which is simply laid down in the mould, and easily vented. The steam ports will cut through the valve face alike every time, which is also a great advantage to the machinist. The plan and elevation as shown in Figs. 5 and 6, fully show its construction. The print parts of the core should be made a little smaller than the prints, so that they will set down easily and avoid crushing. The pattern maker should always bear in mind that after a core is rammed up in the box, and then relieved from it, it swells a little. Then in the baking the tendency is for it to swell, and a coat of blacking on its surface adds to it again; while the mould on its relief from the pattern has a tendency to become smaller. The false end *C* is simply set in loose to make the core right and left. The piece *K*, Figs. 5 and 6, is made loose, held by two dowels, and is made of hard wood. The whole half core is made in one, bedding rods and wires in the ports and main core, thus holding them firmly together. The vent wire is run from the center of parting; clearance for the rod *S* is made in the center of round core, then turned over on a level plate and the box drawn off, leaving the loose piece *K* behind. This is drawn out by sliding it round the body of the cylinder core, all its lines being made concentric with that curve, except the valve face, which is relieved by the motion. When the cores are dry, the rod *S* is bedded in the center and the half cores are pasted together and bound round with wire. The stuffing box core is also made in halves, the size of half the rod *S*. bedded in the center, and when dry the halves are pasted together on the rod in its place, and also bound with wire. The part of the rod between the main core and this core is tapered so that it can be easily driven out when the casting is cold. This arrangement can be used when the steam chest is not cast on by using a print tieing the whole of the cores together on the valve face. The same considerations may be applied to patterns of pipes, columns, &c., with flanges turned upon them.



Aluminum for Mechanical Purposes.

In a recent address on Engineering Progress Mr. Chas. Latimer, Chief Engineer of the New York, Pennsylvania and Ohio Railroad, ventured the prediction that aluminum was destined at no distant day to replace steel for rail and bridge construction. Great progress has been made during the last few years in the reduction of aluminum from its ores, and we believe the day is not far distant when it will be used extensively in the arts; but the hope that it will replace steel in positions where great strength and durability are required, seems visionary. Aluminum is remarkable for its low specific gravity; for its resistance to oxidation and corrosion, and for the high polish that it assumes. These attributes will recommend the metal for many mechanical purposes, when its price becomes low enough to bring it into popular use. It is also likely to prove valuable as an alloy, but it has not a high tensile strength, which will prevent its application to the purposes spoken of by Mr. Latimer. The metal occurs abundantly in nature in the state of silicate, as in feldspar, and its associated minerals; also in the various clays derived from that source. The great chemist, Wohler, was the first who succeeded in obtaining pure aluminum, and his process of reduction was very complicated and expensive. Various chemists labored for years to obtain the metal by cheaper methods, but no great improvement was made in its production until a year or two ago, when James Webster, a native of Montrose, Scotland, discovered a new process, which has made the application of aluminum to ordinary mechanical purposes practicable.

Defects in Steam Boilers.

The March number of the *Locomotive*, published by the Hartford Steam Boiler Inspection and Insurance Company, presents the following table as a summary of the work done by the inspectors of that company during January of this year:

Visits of inspection made	2,818
Whole number of boilers visited	5,998
Whole number of boilers examined internally	1,919
Boilers tested by hydrostatic pressure	263
Boilers condemned	39
Total number of defects reported	3,002
Total number of dangerous defects	672

The following table gives the defects in detail:

Nature of Defects.	*Whole Number.*	*Dangerous*
Cases of deposit of sediment	300	29
Cases of incrustation and scale	504	25
Cases of internal grooving	6	3
Cases of internal corrosion	74	11
Cases of external corrosion	129	22
Broken and loose braces and stays	54	25
Settings defective	127	25
Furnaces out of shape	93	5
Fractured plates	92	37
Burned plates	85	36
Blistered plates	194	33
Cases of defective riveting	268	111
Defective heads	47	11
Serious leakage around tube ends	524	151
Serious leakage at seams	152	31
Defective water gauges	73	18
Defective blow-offs	35	8
Cases of deficiency of water	23	15
Safety valves overloaded	40	29
Safety valves defective in construction	39	20
Pressure gauges defective	141	25
Boilers without pressure gauges	2	2
Total	3,002	672

"*Defective riveting* of seams is a more common defect than is generally supposed. When a seam is well riveted, every rivet fills its hole perfectly; there are no cavities around the rivet shank to cause leakage. But the leakage in itself is not half so serious a matter as the weakening of the joint, which necessarily results from the deficient bearing surfaces between the shank of the rivet and the sides of the hole. To attain the maximum strength of a riveted joint, it is necessary that the tensile strength of the net section of plate between the rivet holes, and the resistance to shearing of the rivet shank, shall be equal. But this condition necessitates also at least a *fair*-fitting rivet, in order that the bearing surface may be sufficient to give a firm, unyielding joint.

"The presence of defective rivets in a seam is very easily shown on new work by the hydrostatic test. Where a rivet does not fill its hole, at least fairly well, it will leak badly, where pressure is applied, and no amount of caulking around the thin edge of the head produced in hand-riveting will make it tight. The only remedy is to cut out the rivet and drive a new one in its place.

"Machine-driven and button-set rivets, as a rule, fill the holes much better than hand-driven ones, but care must be exercised or the work may be unsatisfactory. The staunchest riveting seems to be done with that class of riveting machines which have facilities for squeezing the plates tightly together before driving the rivet."

A Modern Railroad Disaster.

An extraordinary railroad accident happened to the Chicago limited express train on the Pennsylvania Railroad, near Salem, Ohio, on the morning of March 20th. While the train was running at a speed of about forty miles an hour, the boiler of the locomotive exploded, hurling the engineer and fireman into the air and killing them instantly. The violence of the explosion was so great that it tore the locomotive into fragments, and made an opening in the track at a point where there was an embankment thirty feet high. Seldom in the annals of railroad operating have the conditions for a sanguinary accident been so fearfully brought round; yet, with the exception of the two unfortunate men who were killed by the explosion, the accident passed without loss of life and with no serious injury. The shock which deprived the train of the guidance of its locomotive, and opened the way down the em-

bankment, also fractured the air-brake pipes, and the brake was instantly self-applied. This checked the speed so promptly that only the baggage car and smoking car went over the bank, and the brakes prevented the hind cars from acting as a battering ram on those in front. Several of the passengers were rather badly bruised through being tumbled round in the cars that left the track, but none of them are in danger of suffering permanently from their injuries. This accident is a striking example of how effectually improved mechanical appliances have succeeded in reducing the fatality of railroad accidents. But for the efficient automatic brake, which instantly caught hold of the cars and kept them from pounding each other, or the strong platforms that received the shocks without yielding, there is no reason to believe that this accident would have been less sanguinary than the worst disasters known to railroad history. The train was crowded with passengers, it was running at a high rate of speed, and the accident happened at a point where the cars would have made terrible havoc had they been hurled together down that steep bank. When an accident of such a nature happens to such a train without bloodshed to passengers, the traveling public may feel satisfied that dangers of railroad traveling are terrors of the past.

Agricultural Machinery in India.

A very successful exhibition has just been closed at Calcutta, India, where an immense quantity of native products, implements, and machinery was displayed side by side with the improved products, implements, and machinery which Western civilization is offering for Oriental adoption. From reading over a descriptive report of the exhibition, we hardly think our manufacturers are prepared to compete vigorously with those trying to obtain a share of the Hindustan trade. The native plow costs from 50 cents to $2, and the natives do not take kindly to foreign made plows, because the makers do not properly provide for an immemorial custom of Indian plowing, where a man would hold the plow with one hand and grasp the tails of the oxen with the other. This is a line of innovation over which the plowmen of "India's coral strand" will not pass. They stick to the tails of the oxen as persistently as they hold to the tails of the plow. Among the favorite foreign plows exhibited was the Avery Hindustan-American plow, which was an adaptation of an American plow to Indian needs. In several instances there were indications that imitations of American agricultural machinery were finding some favor. In every case, however, the exhibitors were British.

Another inventor has entered the struggle to solve the problem of air navigation. One of the great obstacles to this form of locomotion has been the difficulty in controlling any air ship or balloon. The present inventor has labored to overcome this drawback, a part of the invention consisting of an arrangement of horizontally-projecting valved pipes for the discharge and regulation of heated air, whereby the ship may be propelled and steered in either direction. To us the steering gear has too intangible an element to hold on to ever prove a success.

Conflict of Mechanical Opinions.

A correspondent of the *Railroad Record*, Atlanta, Ga., who is evidently well posted on railroad mechanical matters, proposes that railroad companies shall vary their practice of pooling to form a pool for carrying on experiments to prove the value of inventions intended to enhance economical operating. Attention is directed to the fact that one railroad company is abandoning the brick arch and all such smoke-preventing and fuel-saving appliances as worthless, while others are bringing them into extended use. One leading master mechanic holds that the principal requirement to make a side rod safe is rigidity, while another, equally experienced, asserts that the element of elasticity must come into action to secure safety. In numerous other respects there are widely diverse opinions on mechanical matters, and the belief is expressed that the proper way to settle conflicting theories is careful experiment carried out by such a body as the Master Mechanics' Association.

The latest successfully-applied curious invention is the manufacture of boots from vegetable fiber. This has been done in England, and the inducement to abandon leather was the objection of rigid vegetarians to enclose their extremities in any substance derived from animal sources. The inventor of this kind of boot may claim that the invention is new, but every one accustomed to wearing cheap shoes knows that much so-called sole leather is nothing but paper.

Standard Gears.

There has been considerable discussion during the past four or five years on the advisability of the establishment of a standard system of gear wheels. In this discussion there has been no question of the advantages

of such a system, its advocates being able to fortify their arguments by any number of examples showing the entire lack of uniformity in shape of teeth, pitch, breadth of face, size of hole, and general proportions as to strength. This lack of uniformity often makes the cost of repairs a serious matter, besides bringing about vexatious delays, much of which would be avoided if uniformity of practice could be brought about. It is doubtful, however, if the loss in these respects bears much proportion to the cost of the multitude of patterns made and kept in the different machine shops in the country, and seldom used, often only a single time. In cut gearing a great deal of expense is also involved in providing the necessary machines and appliances for producing; machines which, in many shops, stand idle the greater part of the time, but which must be at hand for the occasional job. This, to say nothing of the cost of getting ready to do, and doing, a small amount of such work occasionally, as compared with doing it by the quantity, with machinery exactly adapted to the purpose. Looked at in this light, it is probable that a large proportion of wheel gearing used could be, as many other standard parts of machines now are, manufactured and sold to users greatly to their advantage.

Probably some such considerations as these led the Brown & Sharpe Manufacturing Company, something like two years ago, to commence the preparation of the necessary tables of dimensions, and the construction of patterns and approved machinery, for the manufacture of gear wheels proportioned in all parts from the pitch, and hence uniform and interchangeable. In this they have so far progressed as already to have printed a list of sizes in stock, which, although only the beginning of the enterprise, embraces a large variety from which to select. These are in two classes, viz., "combination gears," so called from being especially arranged for an extended combination for transmission, and "change gears," in which are embraced such as are used for screw cutting, and for other purposes where it is desirable to provide for frequent changes in velocity ratio. In the former of these classes the teeth are of the epicycloidal form; in the latter, of the involute. These gears are, in each case, made in three styles, viz., plain, web and arm, and are cast from accurately-constructed metal patterns, and cut by automatic machinery. Eventually the list will include all classes of gearing, spur, bevel and worm, with teeth both cast and cut. From their extended experience both in making and cutting gear wheels for customers, and in the manufacture of cutters for the teeth of wheels, the Messrs. Brown & Sharpe are particularly fitted for this business, and there is no apparent reason why the effort to reform the practice in relation to the use of wheel gearing shall not be successful. It would seem to be particularly advantageous in the instance of many machine shops in which gearing is required to some extent, but not in sufficient quantity to warrant the expense of machinery for its accurate production. In such cases, gears can be ordered direct from stock, had without delay, and at a trifling expense compared with cost of patterns and making; while the "standard" principle of their construction provides for repairs with the least possible delay and expense. Altogether, the enterprise is one of magnitude, involving a large outlay, and one that will be watched with interest.

The unprogressive spirit of English law is well illustrated by recent complaints as to the oppressive rating of machinery for taxation. According to a law passed in the days of good Queen Bess, machinery is liable for heavy taxes for the support of the poor, probably on the old notion that machinery deprived laborers of work. In some districts of England this tax has become so heavy on some manufacturers that they are hardly able to carry the burden, and are calling out for relief in the way of equalized taxation.

Transmitting Power by Electricity.

The question of the expense of transmitting power by electricity has recently occupied the attention of Prof. Osborne Reynolds, who made it the subject of a Cantor lecture in England. His conclusions are: Thanks to the experiments of M. Deprez, we know that a current of electricity equivalent to 5 horse-power, may be sent along a telegraph wire $\frac{1}{6}''$ diameter, some ten miles long—there and back— with an expenditure of twenty-nine per cent. of the power. Messrs. Hems send 500 horse-power along a $\frac{3}{4}''$ wire rope. To carry this amount, as in the experiment of Deprez, 100 telegraph wires would be required; these, wound into a rope, would make it 1.4″ diameter, four times the weight of Messrs. Hems' rope. With the moving rope the loss per mile is only 1.4 per cent., while with electricity it was nearly 6 per cent. With the Hems rope the loss at the ends in getting the power into and out of the rope amounted to 2.5 per cent.; in Deprez experiments 30 per cent. was lost in the electric machinery alone, which is very small machinery comparatively. This does not include loss of power in transmission to and from the electric machinery. Taking the whole result, it does not appear that more than 15 or 20 per cent. of the work done by the steam engine could have been applied to any mechanical operation at the other end of the line, as against 90 per cent. which might have been realized with the wire rope transmission.

The Smallest Locomotive in America Doing Work.

The Central Wharf Railroad Shops, Pensacola, Florida, has recently turned out the smallest locomotive ever made in the United States for regular service. The miniature locomotive, which is as perfect in its mechanism and equipment as the huge mastodon locomotive, was designed by Mr. John Douglas, the master mechanic of the work, and was built under his direction. The engine is for a 20 inch gauge road. The cylinders are 5″x8″; driving-wheels, 12″ diameter; wheel base, 7′ 9″. The boiler is 2′ 8″ diameter; 4′ 3″, greatest height above rail, and has 97 flues $1\frac{1}{2}''$ diameter. The tank is made to carry 180 gallons of water, and the coal bunkers have a capacity of 250 pounds. The whole machine is 9′ 6″ long, 4′ 6″ wide, and weighs, in working order, three and one half tons.

A novel feature about the little engine is the mounting of the main frame upon two four-wheeled trucks, one being the driving truck, which is connected to an intermediate axle hung in the middle of the frame with a special bearing, so as to allow the driving truck to move around its center to adjust itself to the irregularities of the road. This arrangement gives great freedom in passing the sharpest curves, and the long wheel base gives a steady motion to the engine on the track at a high rate of speed.

The engine was set to work hauling construction material on the wharf, the track being very uneven, but she operates very satisfactorily. She pulls 15 loaded cars, weighing about 45 tons, and handles them easily. A pressure of 80 pounds is carried, and the valves are planned to cut-off at $\frac{3}{4}$ stroke.

A representative of the AMERICAN MACHINIST has made several visits to the yard of the Russel Pavement Company, New York, where the Triple Thermic Motor is at work. The superintendent in charge has so far declined to let him see the motor, but promises to permit a thorough examination to be made some day in the near future.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

Horace B. Miller, Pres't.

Jackson Bailey, Vice- Pres't.

Lycurgus B. Moore, Treas. and Sec'y.

96 Fulton Street, New York.

Jackson Bailey, Editor. Horace B. Miller, Business Manager.

F. F. Hemenway, Angus Sinclair, } Mechanical Engineers.

The American News Company,
Publishers' Agents, New York.

The International News Company,
11 Bouverie Street (Fleet Street), London, Eng., will receive subscriptions for the American Machinist, at 14/7 per annum, postage prepaid.

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NEW YORK, APRIL 19, 1884.

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National Aid Needed for Apprentices.

While the press and the mechanical public are lamenting the decline of skill among mechanics and other artisans, consequent upon the decline of the apprentice system, it is well to seriously consider a remedy that shall act not merely temporarily but permanently. Unless the supply of good thorough mechanics increases at a greater rate than it is now doing, without depending upon any foreign supply, the United States will not make as rapid progress in manufactures and the mechanic arts in the future as has been done in the past. The principal European countries afford direct government aid to the training of mechanics with manifest advantage to their manufacturing interests. Our own National Government never spends a dollar to assist mechanics to learn trades. Recently a bill has been introduced by Senator Blair to apportion funds from the national treasury among the several States for the better support of common schools, and the plan has been favorably received and commented upon by a portion of the press in every section of the country. It seems to be conceded that such appropriations would be both just and proper. Why then would it not be wise for the General Government to devote some portion of such educational funds to the direct instruction of apprentices in shops? State governments are not yet inclined to devote any money for the training of mechanics and probably will not, at least to any appreciable extent, until the national government first extends aid in this direction. It is not necessary to appropriate any part of such a fund to technical schools. It should all be applied to aiding apprentices to acquire trades in established shops. The Government should require each State to add proportionately to the amount received from the National Treasury before expending it for the purpose specified. An amendment to Senator Blair's bill might compass this plan, or a new bill might be introduced. If our country is to keep up its manufacturing and mechanical progress and not let European nations get ahead of us, something must be done to stimulate the training of more mechanics. In our opinion this will not be accomplished satisfactorily or permanently until the National Government extends direct pecuniary aid to the instruction of apprentices.

Electric Propulsion for the Elevated Railroads.

The operating of the elevated railroads of New York interests so many people directly that it is quite natural they should devote close attention to the details of the management. It has, therefore, come to be regarded as a matter of course that a certain portion of the community should periodically through the columns of the daily press express their views as to how the roads ought to be operated. The ordinary run of opinions thus expressed is from parties having no special knowledge of the subject they wish to enlighten their neighbors on, and their views are received at their true value. A writer more pretentious than the usual type of railroad reformers, has recently been claiming attention. Mr. Thomas Whiteside Rae, C. E., wrote a long communication to the *Railroad Gazette*, asserting that by adopting electricity as a motive power the elevated railroads could do the work for $1 that now costs $2.28. He backed his opinion by a long array of calculations that were supposed to prove the facts. When a civil engineer presumes to be an authority on a matter of this kind, it is a decided advantage for him to understand the subject. The letter and the calculations prove that Mr. Rae knows very little about the power needed to operate trains that are frequently stopping and starting. His letter is that of a blind advocate with all his prejudices in favor of electricity, the expense of applying power in that way being made diminutive, while the expense of operating by steam is greatly magnified. He figures the power needed to move elevated railroad trains as if they were kept at a nearly uniform motion from the time they started till they reached their destination. It is not surprising that calculations of train resistance which ignored the extra power expended in starting trains every few minutes should have led to the erroneous conclusion that the locomotives on the elevated railroads were consuming the enormous quantity of 28 pounds of coal per hour to the indicated horse-power. An investigation would have shown that about one-sixth of the quantity named was near the correct figure. In calculating the expense of changing from the use of steam locomotives to electro-motors, Mr. Rae's figures are about as far out as those relating to the power needed to operate the trains.

There have been numerous attempts made to force electro-motors into service, without their merits as a motive power being the recommendation. There is a strong flavor of stock-jobbing about most of the electric railroad schemes brought before the public. There is no electric railroad scheme to-day that can stand on its own merits as an enterprise worthy of public confidence. The era of electrical locomotion is probably coming, but it has not yet arrived, and attempts to force electric motors that are more expensive than steam locomotives into premature use will bring disaster upon the men who put money into such enterprises. *Bona fide* railroad companies may be safely permitted to judge for themselves what kind of power is best adapted for their needs. When electricity comes to be conclusively proved more economical than steam, railroad companies will be ready enough from self-interest to adopt that means of moving their trains, and there will be no call for special pleading to teach them their business.

Nearly one hundred new applications for membership in the American Society of Mechanical Engineers have been made since last November, and will be voted upon at the spring meeting in Pittsburgh, May 20th. Among the candidates for membership are a number of old and widely known engineers who have watched the rise and progress of the young society with interest, but whose conservative views have perhaps prevented them from making earlier application to join it. The stability and standing of the society are now so strongly established as not to admit of a doubt.

The first session of the Pittsburgh meeting Tuesday evening, May 20th, will be devoted to the reading of papers, discussions and other business. Wednesday morning will be devoted to visiting mills, glass works and other places of mechanical interest; Wednesday afternoon and evening to the reading of papers and discussions, Thursday morning to an excursion over the West Penn. and Allegheny Valley Railroads, Thursday evening to a subscription dinner, and Friday morning to a steamboat excursion up the Monongahela to the Edgar Thomson Steel Works.

Our recent suggestion about changing the color of the badges at this meeting has been adopted. The members will wear red badges, and the Prohibitionists (blue ribbon men) who hold a convention in Pittsburgh at the same time will thereby be kept from making any mistakes in mixing with friends, and will not be in danger of being invited up to the bar to "take something."

We have received numerous inquiries as to what we think of a new furnace scheme held by the Blanchard Manufacturing Company, New York, which they claim produces steam with hardly any expenditure of coal. What we know about it is easily told. A representative of the American Machinist called on the secretary of the Blanchard Manufacturing Company and asked permission to examine the boiler, but was refused. The secretary said theirs was a private business in which the public were not interested, and he was not ready to show anything to newspaper men. On the suggestion being made that the public were interested in knowing what the furnace amounted to since stock in the company was being offered for sale, the secretary became angry and denied that any stock was for sale. He also said that it would be bad for the American Machinist if we said anything against the furnace. The American Machinist man then expressed the belief that the furnace was not worth much or they would not be afraid to show it to a practical man, an opinion which did not seem to soothe the irate feelings of the official for he became at once abusive. Here the interview ended.

The economy of using shop tools with reasonable care is not alone that they last longer; if it were there would be better argument in using them under all circumstances for all they could do. It is principally in the fact that tools overstrained by being crowded beyond their intended capacity will be used for years afterwards at a disadvantage that will more than balance what is gained by an occasional spell of crowding. A lathe spindle sprung or out of round is a particular nuisance that is sometimes endured indefinitely to pay for one "rushing" job.

A correspondent, on another page, offers a simple rule for determining the bursting strain of revolving wheels. This rule, for which absolute exactness is not claimed, seems to give results near enough for most practical purposes by the use of very few figures.

A reader sends us the following inquiry:

Will you oblige me by informing me through the columns of your appreciated paper how I can obtain a copy of the number of February 7, 1880, or the information contained therein in reference to worm gearing?

We will answer this for the benefit of all who wish information of the kind. Order the copy wanted of any newsdealer. It can soon be obtained. We can supply back numbers from the date mentioned to the present time, promptly.

There must be quite a demand for machinery and appurtenances for water-works in Texas. A dozen or more towns in that State are reported as either about to build water-works or as already having commenced to build. Every few days the Texas newspapers report another town as proposing to have public water-works. Progress is rapid in that State, and, when a project of this kind is seriously considered by the citizens of a town, speedy action is likely to be taken.

The manufacture of wire nails is an industry that is now receiving quite an impetus in this country. It has not, as yet, reached large proportions, but bids fair to grow rapidly. There are about a half-dozen manufacturers of wire nails now in business, and two or three companies have lately been organized to come in for a share of the trade. By means of automatic machinery, wire nails may be made quite cheaply. In France they are used more than cut nails.

Locomotive Building in Russia.

A report has been passing around our technical journals that an American locomotive-building establishment had received a large order to build locomotives for Russia. We contradicted this report two months ago, but it still continues to go round. So far from requiring to purchase locomotives from other countries, Russia is now in a position to sell engines made in its own factories. Twenty years ago Russia had not the means of building any locomotives; to-day the supply is in excess of the country's needs. This notable change illustrates what protection and encouragement of native industries can do in a few years. In 1868 the Russian Government decided that all locomotives needed for the railroads of the country should be made at home, and it arranged to pay a bonus to native makers for each engine turned out. This stimulated the progress of native mechanical industry so much that several factories are able to build locomotives for private buyers. The type of locomotive used in Russia has a close resemblance to the American engine, which was the favorite there before the native builders began to supply the demand.

Literary Notes.

MASTER CAR BUILDER'S ASSOCIATION REPORT.

We have received the report of the proceedings of the 17th annual convention held at Chicago in June last. It covers the wide variety of subjects respecting railroad car matters discussed at that meeting. Full texts of the various reports are given, with the discussions upon each. Numerous cuts are used to illustrate the subjects considered. A table, with cuts, is published to illustrate the proper proportions for Sellers' standard screw thread nuts and bolts. We think this should be published separately, and copies pasted in every railroad tool room and car shop. The Master Car Builders' Association deserves the very highest credit for its missionary labors in favor of uniform screw threads, but knowledge advances slowly, and there are still many men in the deepest darkness respecting this subject. A striking feature about this report is its index. As a rule the index of a technical report is so meagre that it has no value. Mr. Forney has made this index a commendable exception, for it is so exhaustive that any item of interest in the report can be identified at once in the index.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(166) H. E. G., Allegheny City, Pa., asks: 1. What per cent. of power is lost by back pressure in a locomotive cylinder, and how much of this is due to restricted exhaust passages? *A.*—The back pressure varies with the conditions. The loss of power is in some cases as little as 2 per cent. and in others 15 per cent., or even greater. It is all due to restricted passages, in the sense that it is possible to conceive of the passages being so ample that the back pressure would be practically nothing. It is not, however, practicable to make so free passages. In locomotives it is necessary to employ some means to increase the draft, and the means employed is the exhaust steam under some pressure, which creates back pressure in the cylinder. 2. Give me a simple method of boring a new set of live spindle lathe boxes, so they will be in perfect line with the A-ways, and with the tail stock spindle? *A.*—There is no such thing as a simple way of doing this, because it is altogether a good job, and one that requires care and judgment. The kind of lathe and the facilities at hand will influence the way one will naturally go about such work. We have made a good job by using an accurately-turned boring bar 24″ larger than absolutely required. The tail spindle was removed and a bush bored to fit the bar was put in the tail stock. This provided a bearing for one end of the bar, and a temporary box was bolted to the outer end of the head stock for another bearing. The bearing on head stock was set by tramming up to the bar from a straight edge laid across the ways, first near the tail stock and then near the head stock, which secured correct vertical adjustment, and by a piece screwed in the tool post and moved along with the carriage for horizontal adjustment. This plan is, perhaps, as simple as any.

(167) X. Y. Z., Crozet, Va., asks: 1. Would a horizontal boiler be better than an upright for ¼-horse power? *A.*—We should prefer the upright. 2. What should be the size of such a boiler? *A.*—14″ diameter by 36″ high will probably answer. It should have about 6 feet heating surface. By sketching out the boiler you can find out the dimensions necessary to get the heating surface.

(168) H. J. M., New Orleans, La., writes: In Mr. Marshall's articles on boiler making he speaks of mild steel. What is meant by this, and what is the difference in the manufacture of this and other kinds of steel? *A.*—Mild steel is steel that contains a very small per cent. of carbon, and will not harden by the employment of ordinary means, or, in fact, not at all until its nature is changed. We cannot give the different processes of steel manufacture without devoting more space to it than can be spared.

(169) U., Gouverneur, N. Y., asks: How can I drill a 1/16″ hole through a glass plate? *A.*—Holes are sometimes drilled in glass by keeping the drill wet with turpentine, benzine, or petroleum. We have heard it said that dilute sulphuric acid was still better. It is almost impossible to cut some kinds of glass with a drill, however hard the drill may be, and for such it is said a German-silver tube may be used, run like a drill, with the end charged with diamond dust.

(170) Reader, Paterson, N.J., asks: Would a good marine governor be used to any great extent? *A.*—Such a governor, if better than anything yet tried for the purpose, could probably be gradually introduced. For obvious reasons its sale would be limited.

(171) S. S., Auburn, N. Y., asks: What ports and throw of eccentric would be required for an engine 2″x3″ to run at 300 revolutions, and how large a boiler will be required? *A.*—Steam ports ¼″x1½″; exhaust port ⅛″x1½″; throw of eccentric ⅝″ will do very well. Boiler with about 8 feet heating surface.

(172) J. E., asks: 1. Where is the best place to locate a surface blow in a return tubular boiler, and is it an advantage to use a funnel-shaped mouth? *A.*—We think a good plan is to locate the pipe so as to blow from a point a little back of just over the back end of grate surface. A funnel-shaped piece on the pipe, lying horizontally, the open end towards the front end of boiler is advisable. Place the pipe so that by having the water a half gauge higher than you ordinarily carry it, you can blow down a gauge of water before blowing steam, and still have water enough left. 2. Do you think soda will be of use in a boiler to clean out mud, lime, or soapstone scale? We think it probable that it will be of some use. It is easily tried.

(173) J. K., Rockford, Ill., asks: 1. What is the resistance to punching iron and steel with a ⅝″ punch, the metal being ⅝ thick? *A.*—According to Box, the formula for iron is: Sp.=d×t×68 and for steel: Sp.=d×t×120. In these formulæ Sp. is the punching strain in tons (of 2,240), d the diameter of punch, and t the thickness of plate. Substituting the values for iron and Sp.=⅝×⅝×68=26.5+tons, and for steel Sp.=⅝×⅝×120=46 8+tons. 2. Should a punch be straight, or the largest at the end? *A.*—Just perceptibly largest at the end.

(174) J. G., Chicago, Ill., asks: What do you think of the following plan for cleaning a boiler of scale? I have a tank that will hold about five barrels of water, from which I feed my boiler. My idea is to put a pint of vitriol in this tank full of water, a little before quitting time Saturday, inject it into the boiler and let it remain till morning, then let the water out of the boiler without pressure. Do you think this will take the scale off without injuring the boiler or flues? *A.*—We think if it removed the scale it would be quite sure to injure the boiler.

Business Specials

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gears—G. B. Grant, 3 Alden st., Boston; water motors

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass

Patterns & Models, G. D. Lambert, New Haven, Ct.

INVENTIONS perfected, designed, or patented. E. P. Robbins, M. E., Cincinnati, O.

For first-class machine patterns and estimates, address John Valentine, 15 Alling st., Newark, N. J.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Fine tools and special machinery. Horace Thurston, 84 Clifford street, Providence, R. I.

National Chuck and Small Foot and Power Lathes. Lodge, Barker & Co., Cincinnati, O.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Universal grinders for lathe-centers, chucks, angles, or cylinders. C. C. Hill, 84 Market st., Chicago, Ill

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 626 E st., Washington, D. C.

Split Pulleys at low prices, and of same strength and Appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Improved Tack Machinery, made by The Willets Man'f'g Co., can be seen in operation at their works, 57 Clifford St., Providence, R. I.

The "Wax Process" Engravings shown in the American Machinist each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

New Books, relating to steam, the steam engine, mechanics, machinery, and engineering. Send for catalogue. Fred. Keppy, publisher, Bridgeport, Conn.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large: prices low. Frasse & Co., 62 Chatham St., N. Y.

For copies of the American Machinist, dated January 22d, 1881, clean and in good condition, we will pay 25 cents each. American Machinist Publishing Company, 96 Fulton street New York.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

Bound Volumes of the American Machinist for 1880, 1881, 1882, and 1883, for sale at $3.50 per volume, express charges to be paid by purchaser. American Machinist Pub. Co., 96 Fulton Street, New York.

"Painting and Painters' Materials."

The best book for all who paint, deal in paint, or have painting done. $2 25. For sale by "The Railroad Gazette," 73 Broadway, New York.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

Useful Information for Steam Users—A 100-page pamphlet, compiled from the best authorities, on the care and management of the steam engine and boiler, with hints and rules for engineers and firemen. Engineers everywhere should have this work. Send 25 cents in P. O. stamps for a copy. The J. N. Mills Publishing Co., 145 Broadway, N. Y.

Manufactures.

Geo. Peacock, Selma, Ala., is adding a machine shop to his foundry.

Arthur & Burton, White Hall, Md., will establish a carriage factory.

Concord, Mass., is trying to raise money to build a large shoe factory.

Cleburne, Texas, is talking of an oil mill venture, to cost not less than $50,000.

The Carolina Central Railroad is building a new round-house at Lincolnton, N. C.

Machine shops of Western North Carolina Railroad, Salisbury, N. C., are to be enlarged.

Edwin McDowell intends to unite with others and start an iron foundry at Spartanburg, S. C.

Canning & Gill, Selma, Ala., will probably organize a company to build a wagon factory at that place.

New machine shops of the Jacksonville, Tampa & Key West Railroad will be located at Palatka, Fla.

The machine shops of the Texas and St. Louis Railroad were recently burned at Jonesboro, Ark.

F. & L. Kahn & Brothers are building at Hamilton, O., a stove foundry establishment, 140x60 feet, four stories high.

Dr. J. H. Robins will build an iron foundry at Selma, Ala., to make agricultural implements and other castings.

The Marshall Foundry Company has been organized in Hickory, N. C., for making castings, manufacturing machinery, etc.

Charles Butterfield and another party have started a machine shop in St. Louis, to make barb-wire machines and do general jobbing.

The East Tennessee, Virginia and Georgia Railroad Co. propose to erect $100,000 car and machine shops at Knoxville, Tenn., this year.

The Jersey City Electric Light Company are contemplating putting in new boilers and engine, and otherwise reorganizing their plant.

Machinery for expressing oil from castor beans is in demand in Texas. The cotton-seed oil mills are putting in castor oil attachments. The beans are worth about a dollar a bushel at mills.

It is reported that a large iron furnace and agricultural implement factory is to be started, at Calera, Ala., by northern capitalists.

The Ball Engine Company, Erie, Pa., contemplate greatly increasing their capital stock and enlarging their operations. The engine is a decided success.

The *Baltimore Manufacturers Record* says: N. W. Howson, superintendent of the Mount Savage (Md.) Locomotive Works, will build extensive locomotive works in Anniston, Ala.

The Houston, East and West Texas Railway, Houston, Texas, it is reported, will at once erect large machine shops, round-house, &c.—*Baltimore Manufacturers' Record.*

The H. B. Smith Company, Westfield, Mass., are having additional buildings put up, to increase their facilities and number of workmen to turn out steam-heating apparatus.

The McDonald Manufacturing Company, Fond du Lac, Wis., manufacturers of threshing machines, have increased the capital stock of the corporation from $100,000 to $150,000.

A stock company has been organized to manufacture gloves of the hides of prairie dogs. The tannery will be located at Fort Worth, Tex., and the manufactory at Philadelphia.

H. Brewer & Co., Tecumseh, Mich., engine builders and machinists, have completed an addition to their works, 76x54 feet, two stories high, and are putting in new machinery.

The Pierce Steam-Heating Company, at Westfield, Mass., are increasing their facilities for manufacturing, by putting up a two-story building, 90x30 feet, near their present foundry.

Clark, Raffen & Co., Chicago, will soon erect a foundry 100 feet square. It will contain two 30-ton cupolas, and they will run in connection with this a 50x75 feet five-story machine shop.

C. C. Harlow, of Brockton, Mass., has patented an automatic oiler for steam engine cylinders. The article is to be manufactured in Brockton by a stock company, with capital of $150,000.

H. Conant, of Pawtucket, R. I., has recently bought a large lot of land adjoining the Providence Railroad, and it is rumored that he will erect a large mill thereon for the manufacture of Paisley shawls.

The St. Louis *Age of Steel* says: A new works, to be called the Western Bridge and Iron Works, is being established at the corner of Kosciusko and Trudeau streets. Messrs. Breden & Chapman are the proprietors.

The Union Brass Manufacturing Company are putting up a building 38x52 feet in size, on Ohio street, Chicago, to be used for the manufacture of Orme's patent locomotive, marine, relief, and lock-up safety valves.

Richards & Clarke, Omaha, Neb., manufacturers of architectural iron and machinery, and engine builders, are erecting a new foundry building, 60x110 feet, and a new boiler shop, 60x40 feet, and will put in some new machinery.

Reynolds & Lang, Ithaca, N. Y., have issued a new illustrated catalogue of portable and stationary engines, boilers, and portable saw mills, manufactured by them. Some excellent testimonials are published regarding their portable engine.

L. J. Pender, Union City, Ind., is erecting a shop in connection with Smith Brothers for the purpose of manufacturing portable and stationary boilers of all sizes, from one to one hundred horse-power, also all kinds of sheet iron and tank work.

George Gage, Waterford, N. Y., has doubled his working force since January 1st, and has been working nights for the past month—now employing 30 men on machinists' tools and special machinery. Orders for Fox lathes have lately been quite brisk.

The Pennsylvania Steel Company has two draftsmen engaged in making plans for the new building of a new rail and blooming mill. The new mill will be located in front of Bessemer Mill No. 2, and will be supplied with machinery of a new and improved order.—*Steelton Reporter.*

D. Saunders Sons, Yonkers, N. Y., have just sold a 12″ pipe-cutting and threading machine to Braman, Dow & Co., Boston. This establishment is now equipped with Saunders machines, to cut and thread pipe from ¼″ up to 12″, with their patent adjustable expanding dies.

A stock company has been formed, with a capital of $200,000, for the purpose of manufacturing sewing machines in the works lately occupied by the Wilson Sewing-Machine Company, at Grand Crossing. Mr. Wilson, late president of the last-named company, it is said, subscribes $50,000 to the new company.—*Chicago Industrial World.*

The Cleveland, O., *Iron Trade Review* says, The manufacture of a moulding machine that is intended to do away entirely with hand moulders will soon be commenced in this city. The Sweet Moulder Company was organized Monday, with a capital stock of $50,000, and the following officers elected: President, A. N. Benson; vice-president, S. H. Schmuck; secretary, Charles A. Cook; treasurer, L. C. Beardsley. Directors—A. N. Benson, S. H. Schmuck, Charles A. Cook, C. T. Sweet, and Daniel Ruck. The location of the works has not yet been decided.

J. H. Melvill, secretary of the Union Iron and Steel Works, Los Angeles, Cal., writes us: This company has a capital stock of $100,000, and we expect to have a machine shop, blacksmith shop, boiler shop, and a foundry. We are putting up the blacksmith and boiler shops, 40x90 feet, now, and expect to put up the machine shop and foundry in a few weeks, as soon as all the plans are matured. We have a plot of ground 150′x150′. The works will turn out all kinds of heavy forgings, engines, and boiler work, and will also make repairs on engines and boilers.

The Osgood Dredge Company, Albany, N. Y., have just shipped one of their large steam excavators to McArthur Brothers, railroad contractors at St. Paul, Minn. This machine was selected on its merits, after a careful examination of all the machines in market. Nine of these machines are now at work on the Isthmus of Panama, and their performance lately received favorable mention in Lieut. Rogers' report to the U. S. Navy Department. The company report that inquiries for dredges and excavators are coming in from all parts of the world, the latest dredge shipment to a foreign country being to Newfoundland.

The Albany Steam Trap Company, Albany, N. Y. are engaged in fitting up the three-story brick factory building, 78 and 80 Church street, in that city, for the purpose of manufacturing and placing on the market several styles of steam valves, with renewable seat, the invention of James H. Blessing, of that company. So far the valve has been received with much favor. Special tools have been and are being provided, for the purpose of making all parts of the valves interchangeable and reducing the cost of manufacture to the lowest limit. In time, the building will probably be utilized by the company for the manufacture of its steam traps also. The shops, including foundry, are about 60 feet wide by 70 feet deep.

The Ferracute Machine Company, of Bridgeton, N. J., report plenty of work on hand and prospects for the future good. Among their orders now in are several large presses, one for metallic shingles, one for army buckles, one for carriage hardware, one for brass goods, one for deep tin and cuspidore work, two (for export) for embossed drawn work, beside a number of smaller presses, spinning lathes, etc. They are also very busy in their die departments, so much so that they have been unable for some months past to make anything for stock, and are now running solely on orders, and need more die makers than they can get. They are now shipping an order of twenty dipping machines for the Standard Oil Company, and have their orders for other tools. They have added, since the first of the year, a new 30″ lathe, grinding lathe, milling machine, new forges, and other tools. They have a larger number of workmen and are better prepared for work in their line of presses, dies, and special machinery than ever before.

Battle Creek, Mich., expects to get an Ohio iron bridge factory to establish a branch there, employing one hundred men.

The firm of Schutte & Goehring, of Philadelphia, was changed April 1 to L. Schutte & Co. The new firm will carry on the same business as heretofore—engineers, machinists, and manufacturers of special machinery—at 12th and Thompson streets.

Machinists' Supplies and Iron.

New York, April 3, 1884.

There is no notable change in the markets for any kind of metal goods since last week. All lines of this business have ruled dull, buyers continuing the hand-to-mouth practice.

Iron. American pig—Prices steady, most of the out-put of furnaces being confined to contracts for season's supply. No. 1 X Foundry, $20 to $20.50, and a few special makes are held at $21 to $22. No. 2 X Foundry $18.50 to $19.50; Grey Forge, sales light, quoted $16.50 to $17.50.

Scotch pig—Prices irregular, with tendency to favor buyers. Coltness, $21.50, to arrive, and $22 to $22.50 from yard; Gartsherrie, $21.50 to $22; Summerlee, $21.50 to arrive, $22 yard; Carnbro, $20.50; Eglinton, $20.50 to $21; Langloan, $21.50 to arrive; Dalmellington, $20.50 to $21.

Boiler Plate—Tank iron	2 4-10 to 2¼c.	
Refined	2½	" 2⅝c.
Shell	2¾	" 3c.
Flange	3¼	" 4c.
Extra Flange	4½	" 4⅝c.
Fire Box	4½	" 4¾c.
Chester Steel	4¾	" 5¼c.

Antimony—The tone is weak and the demand moderate, with sellers at 11c., from the store, for Hallett's brands; Cookson's, 11⅝c.

Copper—The market for ingots is unchanged. Resales of Lake have been made from 14¾c. to 14⅝c. The rumor is current that large shipments of Lake have been contracted for at 13 to 13½c.

Lead—The market has ruled quiet, and a trifle easier. Lake, 4.15c.; Western, 4.10c.

Spelter—Common domestic, 4.60c. to 4.80c.; Refined, 8c. to 8⅜c.

Tin—The market for pig has ruled easier. Banca, 19¾c.; Straits and Malacca, 18⅜c.

✻WANTED✻

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

A good draughtsman wants situation. Reference given. Address T. C., Am Machinist.

A machinist, experienced in tack machinery, would like a situation. Address "Tacks," care Am. Machinist.

Wanted—By a thoroughly competent machine pattern maker, a situation to take charge of a shop. Best of reference. Address L-box 457, Newport, Ky.

Situation wanted by millwright—Good workman in wood or iron; competent to do any repairs about factory, make patterns, etc. Country preferred. Address "Willing," Am. Machinist.

Wanted—Engine builders to make and introduce new patented engine. Parties that can give inventor employment preferred. Address at once, "Mechanical Engineer," care of Am. Machinist, New York.

Wanted—A first-class pattern maker, one who is accustomed to car-wheel and general pattern work, and who can make his own drawings. Only perfectly sober and industrious men need apply: stating references and amount of pay expected, to Marshall Car-wheel and F'dry Co., Marshall, Texas.

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For the University Register, containing full statements regarding requirements for admission, courses of study, degrees, honors, expenses, free scholarships, etc., and for special information apply to The Treasurer of Cornell University, Ithaca, N. Y.

NOTES IN MECHANICAL ENGINEERING.

Compiled principally for Students, but also of great value to all Mechanical Engineers. By HENRY ADAMS. 93 pages, 12mo, $1. Descriptive Catalogue (100 pages) free.

E. & F. N. SPON, 35 Murray St., N. Y.

THE NEW SOMBART PATENT **Gas Engine**

Best motor for small powers ¼ to 1 *actual* horse power. Send for prices. Sombart Gas Engine Co. Hartford, Conn. New York Office, 215 Centre St.

HILL, CLARKE & CO.

36 OLIVER STREET, Boston, Mass.

BRANCH OFFICE, 800 N. 2nd STREET, St. Louis Mo.

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LIGHT MACHINERY & SMALL TOOLS.

Sent free to Manufacturers and Dealers on receipt of their business card.

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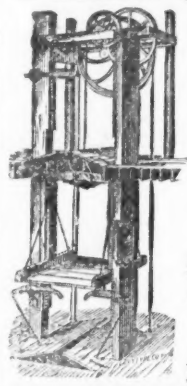

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With most approved Safety Devices such as

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"ECLIPSE" HAND PIPE-CUTTING MACHINE.

Simple, Powerful, Portable, Inexpensive. With it one man can easily cut 6-inch Pipe. Made in three sizes.

Address, for Prices, &c.,

PANCOAST & MAULE,

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FRICTION CLUTCH PULLEYS,

Hoisting Engines and Hoisting Machinery,

D. FRISBIE & CO.,

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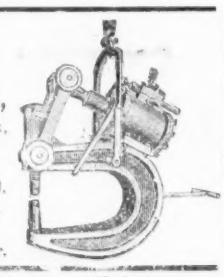
THE ALLEN PORTABLE RIVETER,

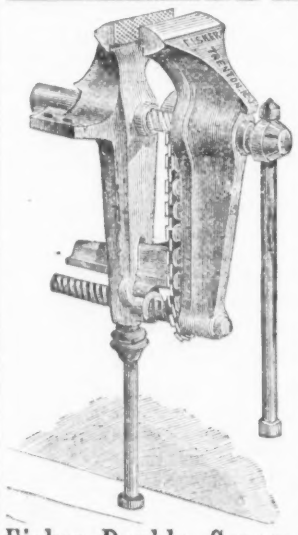


For Boiler and Tank Work, Beams and Girders.

THE ALLEN PORTABLE RIVETING MACHINE CO.

No. 204 Broadway, N. Y.

Henry E. Roeder, Mgr.



Largest size has 8 inch Jaw—opening 10 inches, with 36 inch Lever. Five smaller sizes, at $7 to $27. The only Parallel Vise that will stand heavy work. Send for circular to

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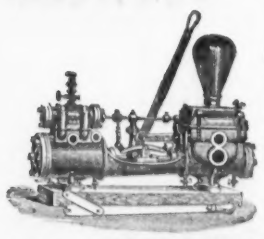

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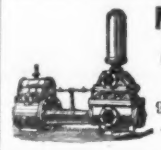

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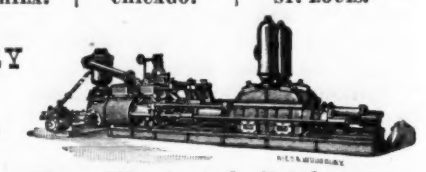

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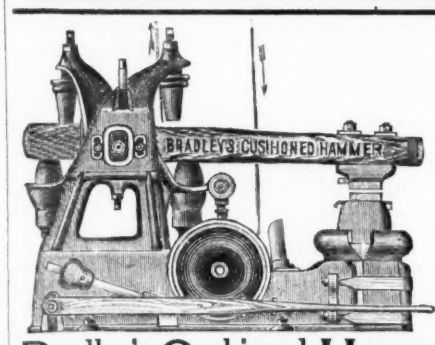

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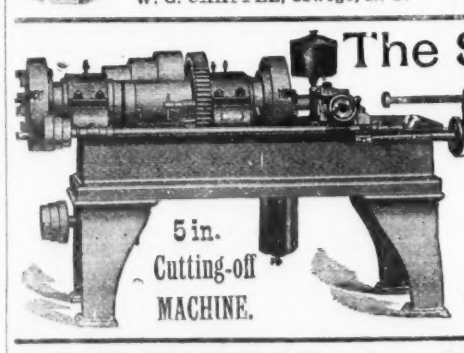

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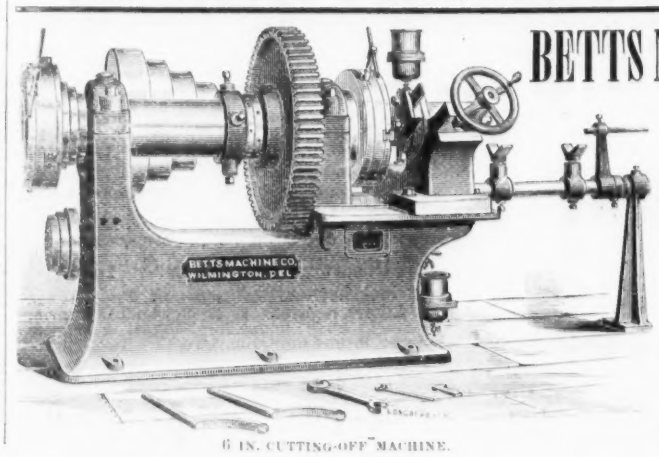

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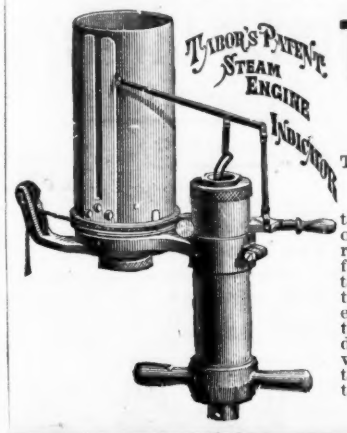

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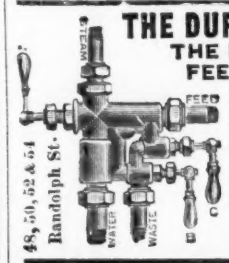

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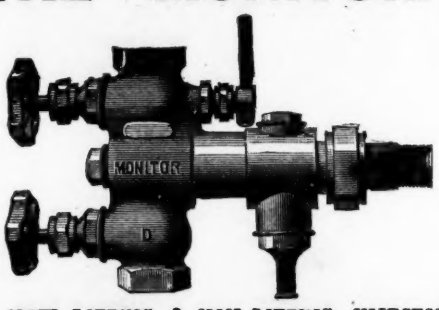

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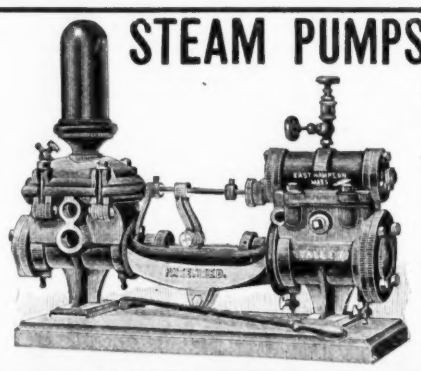

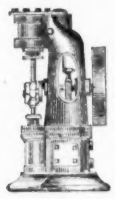
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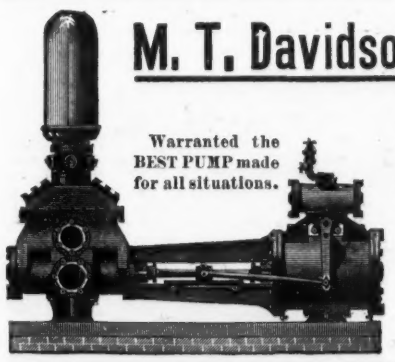
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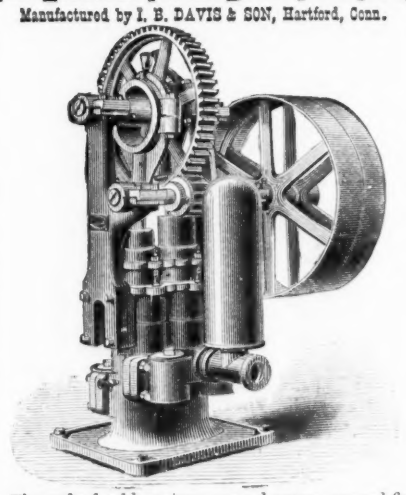
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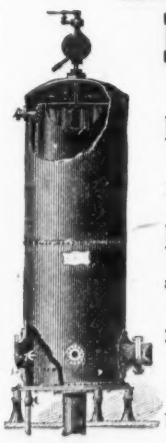
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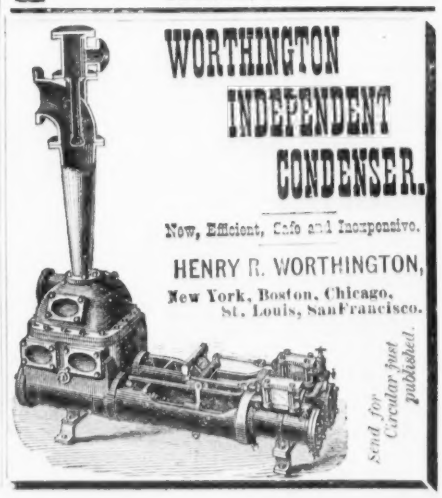

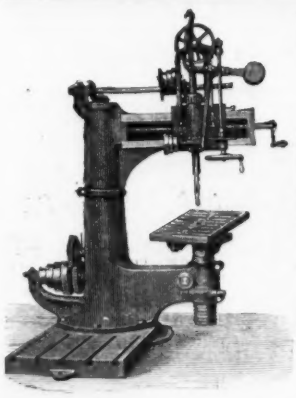
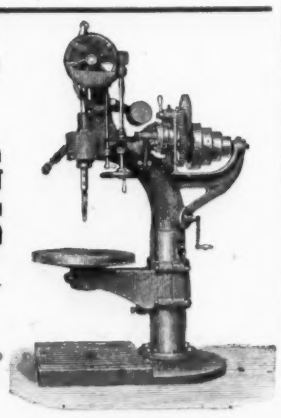
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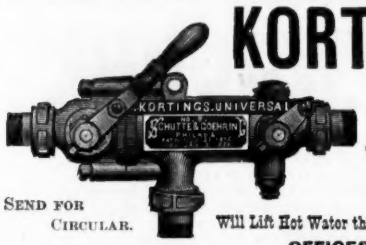

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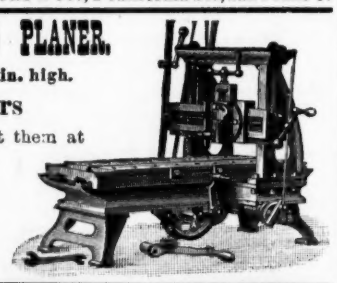

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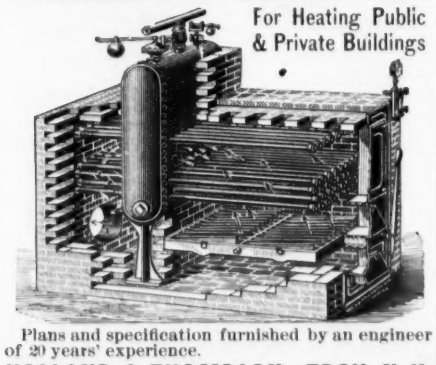

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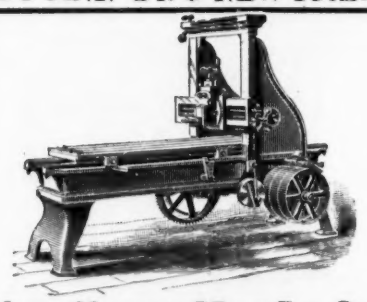

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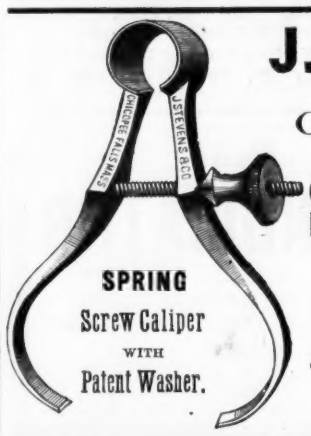

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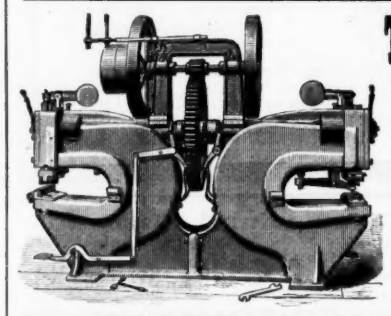

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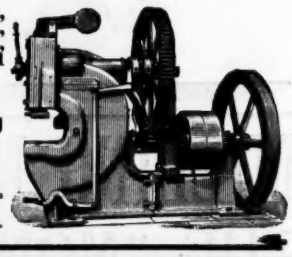

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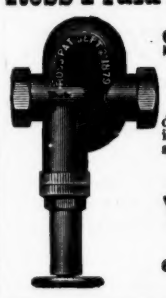

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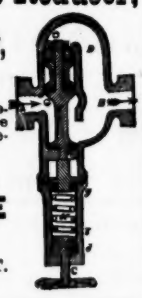

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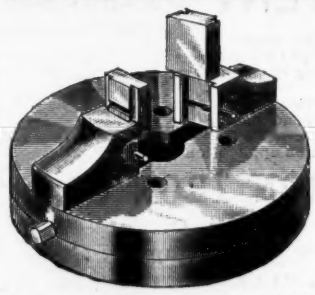

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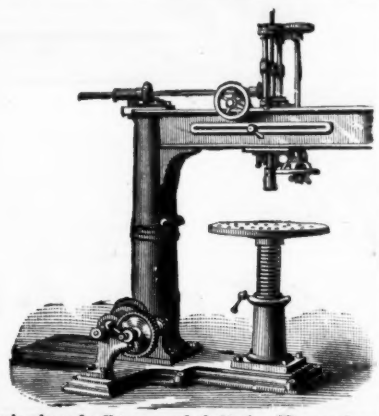

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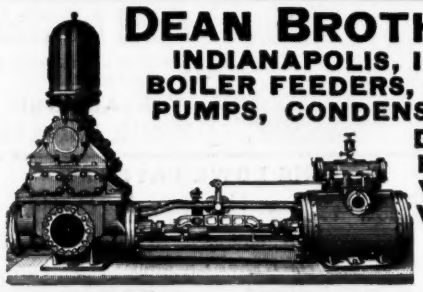

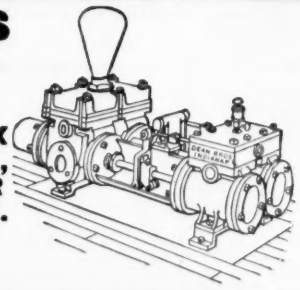

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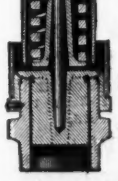

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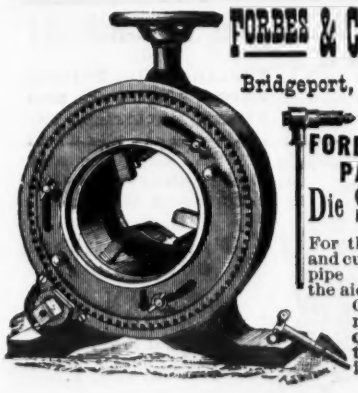

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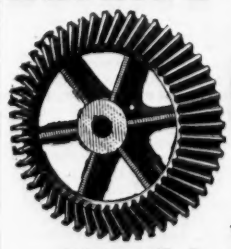

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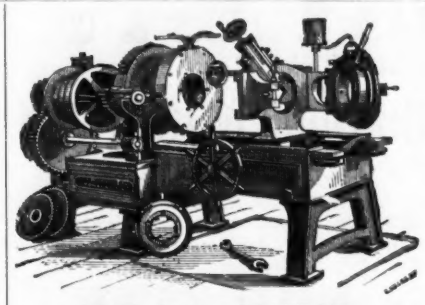

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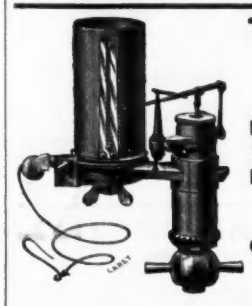

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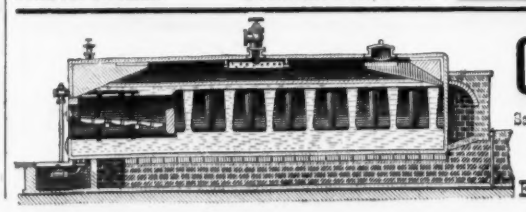

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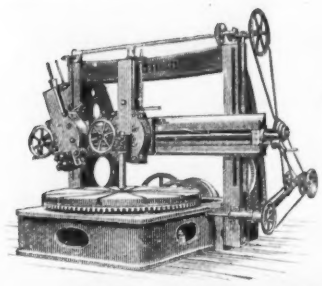

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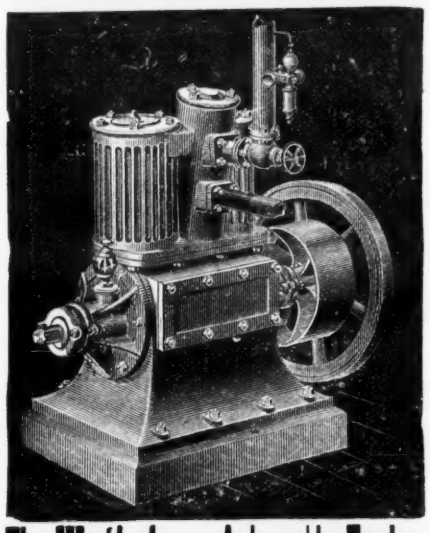

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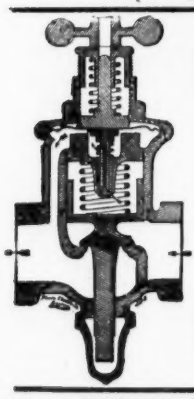

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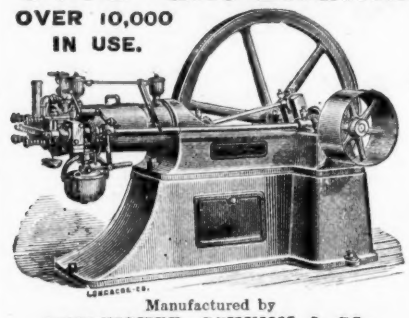

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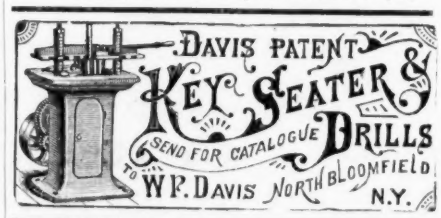

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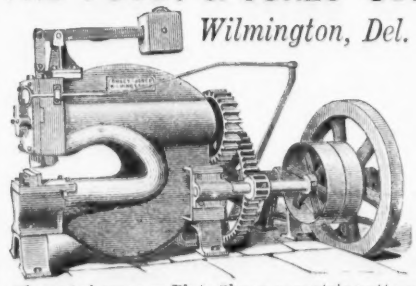

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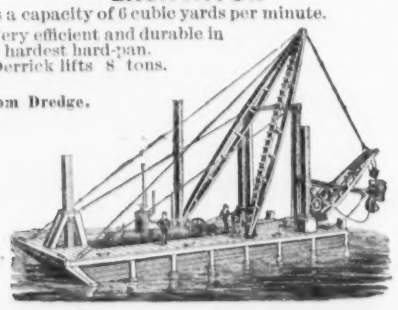

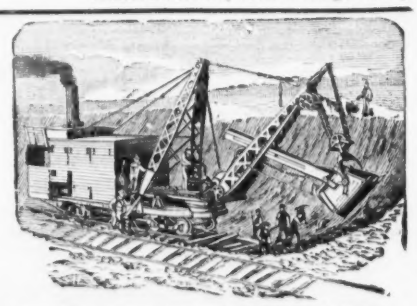

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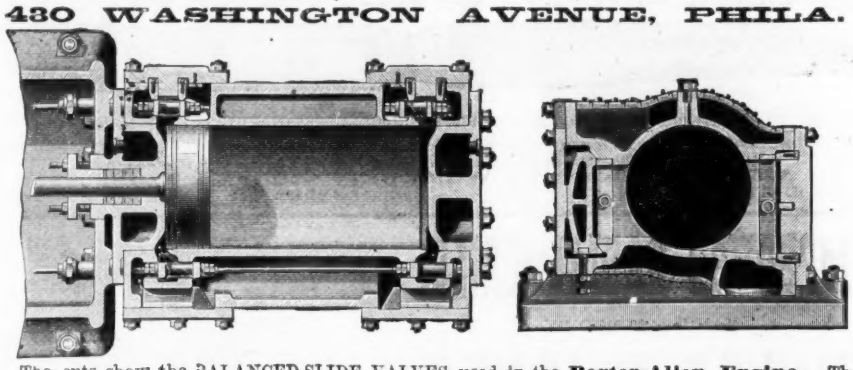

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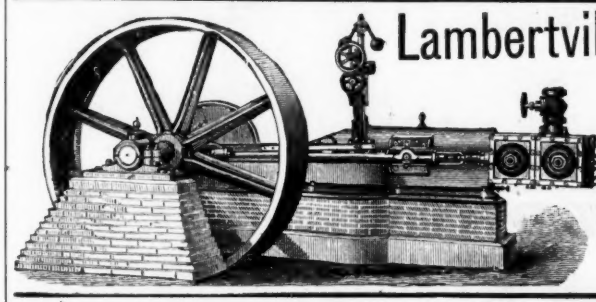

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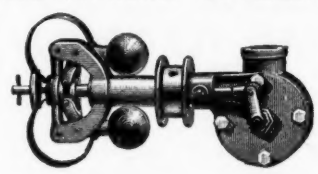

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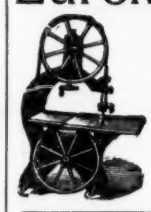

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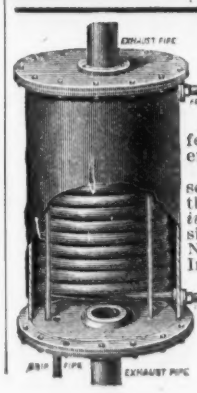

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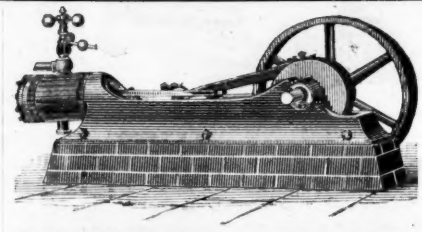

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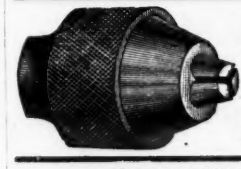

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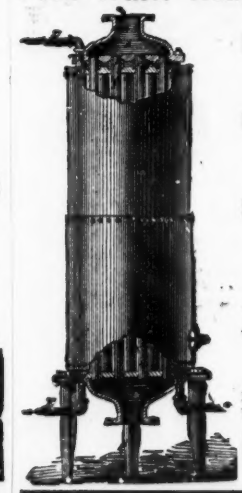

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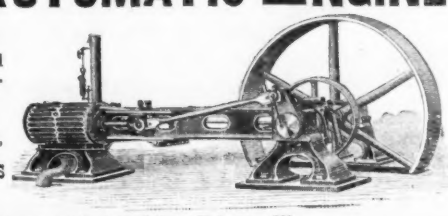

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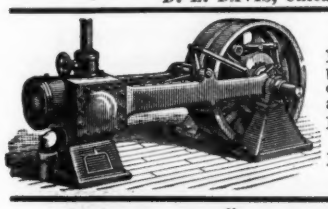

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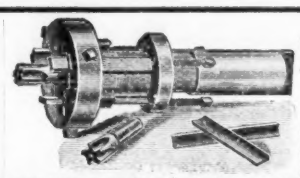

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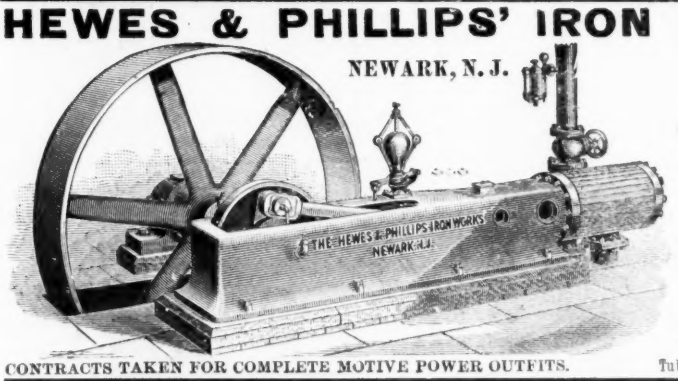

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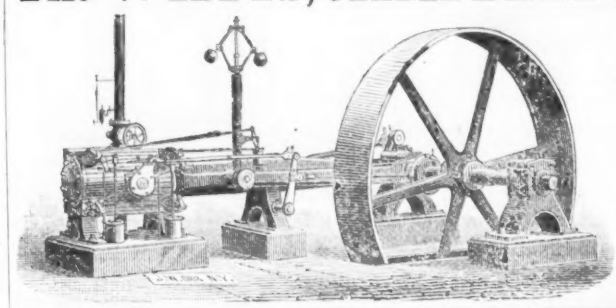

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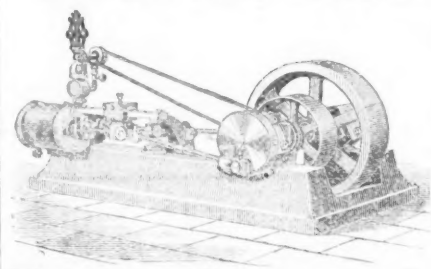

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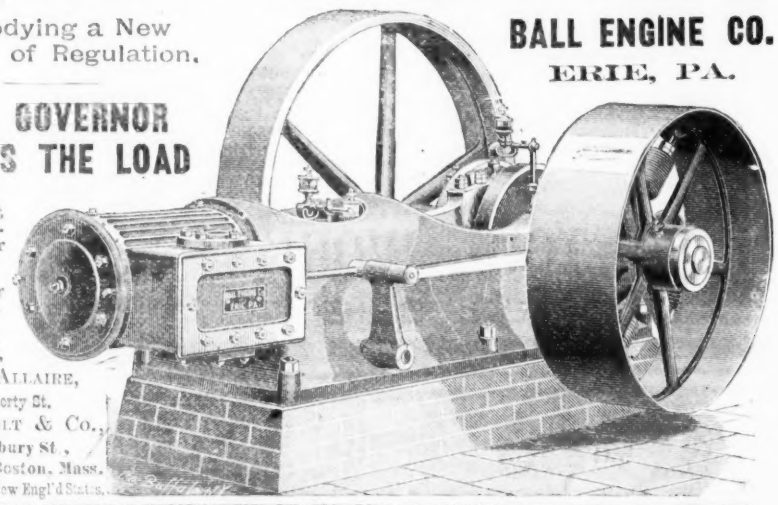

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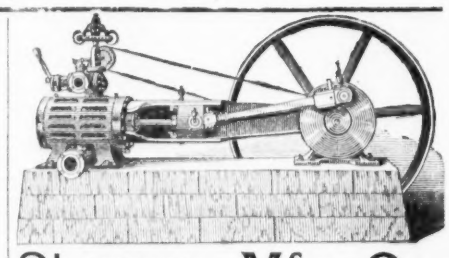

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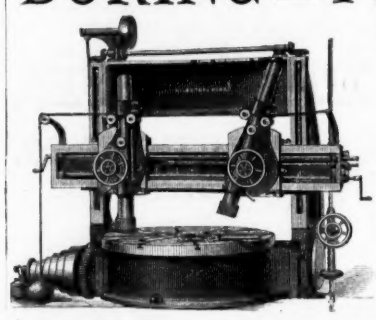

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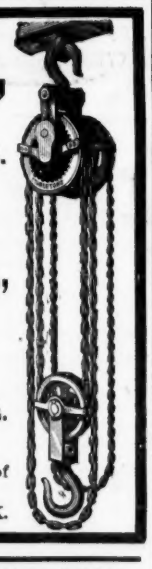

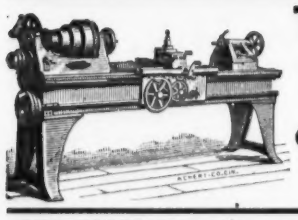

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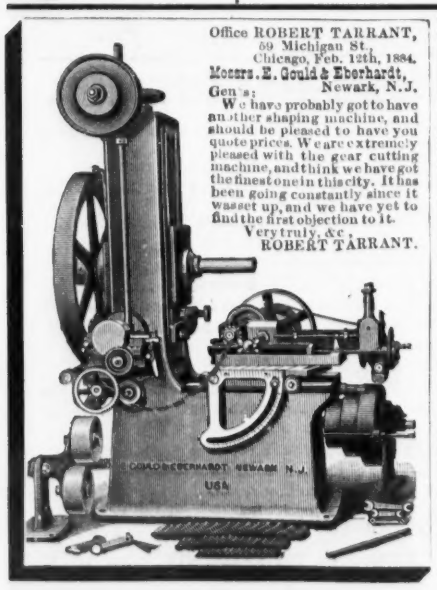

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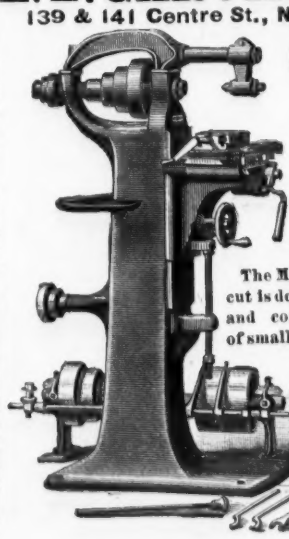

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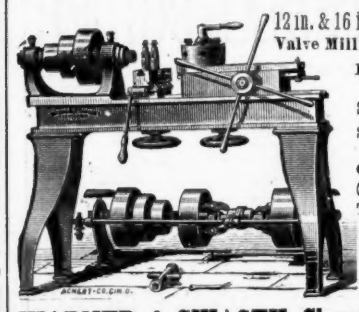

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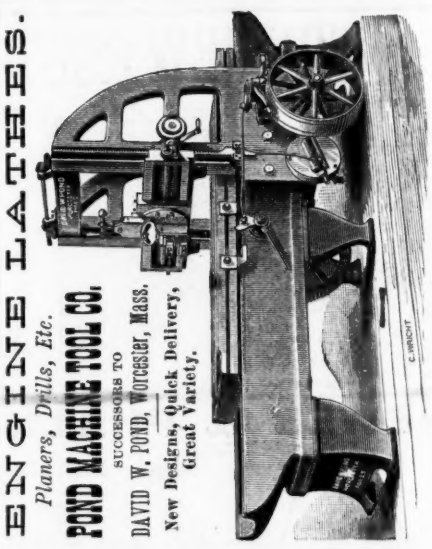

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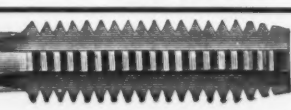

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